REPORT

OF THE

COMMISSIONER OF AGRICULTURE

FOR

THE YEAR 1877.

WASHINGTON:
GOVERNMENT PRINTING OFFICE.
1878.

ORDER TO PRINT.

CONGRESS OF THE UNITED STATES,
In the House of Representatives, June 6, 1878.

Resolved by the House of Representatives (the Senate concurring), That there be printed three hundred thousand copies of the Report of the Commissioner of Agriculture for 1877; two hundred and twenty-four thousand copies for the use of the House of Representatives, fifty-six thousand copies for the use of the Senate, and twenty thousand copies for the use of the Department of Agriculture: *Provided, however*, That the number of pages of said Report shall not exceed six hundred.

Attest:

GEO. M. ADAMS, *Clerk*.

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REPORT

OF THE

COMMISSIONER OF AGRICULTURE.

DEPARTMENT OF AGRICULTURE,
Washington, November 15, 1877.

To the President of the United States:

SIR: By your instruction, and under your direction, I assumed control of the Department of Agriculture at the beginning of the present fiscal year.

An examination of the current reports of correspondents of the department encouraged me to anticipate an unusually favorable harvest, in every direction, from the growing crops of our widespread agricultural domain. These hopes have been fully realized, and I am enabled to state that, with scarcely an exception, the varied products of the country have yielded almost unparalleled returns, affording gratifying evidence not only of the available extent and fertility of our arable lands, but of increasing industry and prosperity among our agricultural population, and of intelligent devotion to the important interests of husbandry.

In presenting this encouraging view of the results of agricultural labor during the present year, there is occasion to congratulate our people upon the success of that industry which lies at the foundation of national prosperity. But with all these evidences of prosperous industry, we may not hope to take that rank among the producers of the world to which we are entitled until we have exhausted all efforts to produce within our own borders, and as a result of our own industry, everything now imported from other nations, which can be obtained from the careful cultivation of our own productive soil, which, extending through so many climes, with its wonderful diversity, offers unparalleled opportunities for the agricultural industries of a self-sustaining, prosperous, and happy nation.

An examination of the Report of the Bureau of Statistics of the Treasury Department furnishes a suggestive exhibit of our annual importation of the agricultural products of other lands. The following are among the

articles imported that can and ought to be produced in the United States, with the value thereof:

Articles.	Quantity.	Value.
ARTICLES FREE OF DUTY.		
Peruvian bark (Calisaya, &c.) .... pounds..	5,744,765	$1,293,400
Bark used for tanning	....	181,826
Cork-bark, unmanufactured	....	606,169
Coffee	339,789,246	56,788,997
Eggs	4,903,771	630,393
Indigo	999,139	794,999
Madder	2,911,958	151,005
Paper-materials	112,447,584	3,854,046
Tea	62,887,143	19,524,166
Total	....	83,827,992
DUTIABLE ARTICLES.		
Barley .... bushels..	10,285,957	7,887,886
Barley-malt .... bushels..	286,930	252,022
Rice .... pounds..	71,561,852	1,693,547
Hemp .... tons..	17,979	2,247,540
Jute and other grasses .... tons..	60,368	2,384,881
Flax-seed .... bushels..	2,755,726	3,859,496
Silk	....	23,745,967
Straw and palm-leaf	....	1,856,674
Wines	....	4,754,110
Wool, unmanufactured	44,642,836	8,247,617
Total	....	56,930,340

The value of sugar and molasses entered for consumption in three years is as follows:

Year.	Values.	Duties.
1874	$92,614,832	$34,860,278
1875	82,209,853	37,157,245
1876	75,742,466	41,898,575
	250,567,151	113,916,098
Annual average for three years	83,522,383	37,972,032
FRUIT AND NUTS.		
Currants	856,425 62	209,110 61
Lemons and oranges	3,412,027 45	682,405 50
Almonds	463,106 86	240,207 89
Prunes and plums	2,333,949 00	553,660 77
Raisins	2,425,277 14	805,526 63
All other fruits and nuts	2,424,480 44	624,318 20
	11,915,266 51	3,115,229 60

Thus it will be seen that $236,295,981, besides the additional expense for freight and commissions, are paid annually for imports, all of which could and should be saved to our people.

Among the imported products of other nations which absorb the capital, retard the industry, and depress the commercial prosperity of the country, that which holds the first importance is the item of sugar, for which we are paying to foreign producers nearly a hundred millions of dollars annually, while we have neglected our natural facilities for supplying our own market and contesting the world's market with this production. Nor ought it to lessen our anxiety in view of this anomalous

fact, that, having made freedmen of our slaves, a great portion of the vast amount we thus contribute to foreign industry goes to sustain and support the slave labor of Cuba, a country which takes from us very little, if anything, except gold, in exchange for her abundant supplies of sugar and tobacco.

It is of the greatest importance in the present stagnant condition of the labor and business of the country that the millions of gold thus paid to foreign nations for sugar and other articles of consumption, which habitual use has made necessary for us, and which we have such abundant natural facilities for producing at home, be saved to our people. Every pound of sugar needed for our home consumption can be produced cheaply on our own territory. The saving of the vast amount now expended in the importation of this staple is, however, but one of the important results which will follow its home production.

The sugar-interest of the country reaches every cupboard in our broad land, and is intimately connected with every branch of the inter-State trade and commerce of the republic; and if the manufacture of sugar be encouraged and developed to the extent of supplying our home demand with home-grown sugars, importations will necessarily cease, and the perpetual flow of American gold to countries with which we have comparatively no trade will be arrested, specie resumption will be assured, confidence restored, and the material prosperity of the country will advance with renewed energy and power under the changed condition of production in this single article of universal consumption.

The great West will purchase the domestic sugars of the Gulf States or California, and pay in flour, whisky, corn, pork, stock, and mechanical implements. Pennsylvania will buy, and pay in coal, iron, and petroleum. The New England States will pay in clothing, shoes, hats, jewelry, cutlery, and other products of their skilled mechanical labor; and the distribution of the 200,000 tons of sugar over this broad land, every year, will give active employment to an army of common carriers and middlemen.

Some hundreds of thousands of acres of the best sugar-producing lands lie on the Lower Mississippi, inundated through the broken levees by every overflow of that great river, and no power except that of the general government is adequate to protect this wide expanse of fertile territory, and give confidence to capital and labor to again occupy and cultivate it.

Individuals, corporations, counties, and States have exhausted themselves in fruitless efforts to protect these lands from overflow, and to restrain the Mississippi within its proper boundaries and navigable channel.

It is a *national* work, for a *national* purpose, and, as it seems to me, a *national* duty at this time to take in hand and push to a speedy conclusion the re-establishment of the broken levees, and the making of such provision for their maintenance as shall permanently secure the valuable

industries that will immediately reoccupy the lands now subject to overflow, and for this reason alone abandoned.

It is claimed by the sugar-planters of Louisiana that the present tariff does not protect the interests of the American producer of sugar in the slightest degree, but that it discriminates against the planter, and gives to the sugar-refiners, who are less than fifty in number in the whole country, a monopoly of the markets.

Such protection and encouragement as the older nations of Europe have always extended to their sugar-interests would apply not alone to the protection of cane-sugar, but also to the manufacture of the beet-sugar (which now in Europe competes successfully with cane-sugars), and the manufacture of which, it is hoped, may soon secure a foot-hold in those sections of the United States where the beet is found to be most rich in saccharine.

I am now engaged in a careful research as to soil and conditions necessary in this country to produce beets or other vegetables, rich enough in saccharine matter to warrant the expenditure of capital in the machinery necessary to the successful manufacture of sugar. Thus far men of means have not seen sufficient assurance of profit to tempt any increase of the industry over past years, and but one manufactory of beet-sugar is now known to be in successful operation.

An attempt on a moderate scale, but with a degree of intelligence and zeal which promises to demonstrate whether success is possible, is now being made in New Jersey, as a preliminary step toward an earnest effort to secure the production of sugar to satisfy at least our home demand by an increase of the growth of the sugar-cane. I entered into an extended correspondence with sugar-planters, chiefly in Louisiana, with very encouraging results, as will be seen from special report No. 1, hereto appended. The liveliest interest has been excited in the subject, and, with reasonable encouragement on the part of the government, the most gratifying and important results may be confidently anticipated.

Among the good results of the former distributions of plants is the knowledge that the Chinese tea-plant can be, and indeed already is, successfully grown in the States of North Carolina, South Carolina, and Georgia, and in other parts of the United States of similar climate.

I have made as thorough inquiry as time would permit as to the facts of tea-culture in this country, and am led to believe that, with proper encouragement, within a few years American tea can be put successfully upon the markets of the world.

In furtherance of this interest I have caused to be prepared an extended paper on the cultivation and preparation of American tea, which will be found in this report, and to which I beg leave respectfully to invite your attention.

I have had numerous applications from communities favorably located for plants with which to commence the culture of the fragrant herb, and officers of certain agricultural associations have eagerly volunteered to

give special attention to the culture by their respective granges and societies.

To meet this encouraging interest expressed in South Carolina and Georgia, I have purchased all the tea-seed that could be obtained from plants grown in this country, and will, as far as the very limited opportunity offered by our propagating-beds permits, provide tea-plants for early distribution the coming season. It is expected that some hundreds of thousands of tea-plants will be sent out during the season of 1878, and that they may be grouped in the most favorable localities, and within four or five years serve to demonstrate the practicability of providing our people with a better article of tea than they now are able to obtain, and the possibility of saving to our country from nineteen to twenty millions of dollars in coin, which annually finds its way into the coffers of British merchants, who have substantially a monopoly of Chinese trade.

A brief notice of the services rendered by the different branches into which the department, for convenience and greater efficiency, is divided, will afford a general view of the specific operations of the past year.

The Division of Horticulture and Arboriculture is one of the most important of the component branches of the department, and contributes materially to the benefits which the public derive from its workings. The laying out of the grounds, the establishment of an extended arboretum, and the cultivation of exotic plants have progressed as the means and the land within the control of the department have allowed. The propagation of plants for distribution is exclusively confined to those species and varieties which are of economic value, those of merely ornamental interest being increased only to the extent necessary for the decoration of the grounds. Although the operations of the horticultural division have been seriously restricted by insufficient appropriations, yet, by an exercise of strict economy, the supply of plants for distribution has been partly kept up. This supply is the result of manual labor, and when that is abridged the propagation and increase of plants are, as a matter of course, reduced in proportion. This circumstance is very unfortunate, as it partially paralyzes the efforts of the department by depriving it of the ability to respond to the great interest that it has awakened in the introduction and cultivation of such new plants as yield products of commercial importance.

The collection of economic exotic plants also awaits completion. As it now stands, it is the most complete of its kind in the country, containing many plants that cannot be duplicated here. It exhibits the various food, fiber, varnish, gum, and medicine yielding plants of note, and furnishes material for physiological, pharmaceutical, historical, and other educational purposes, to those who desire such assistance.

Collections for agricultural institutions are furnished when desired, so far as duplicates can be made available, and of such species as are considered worthy of introductory trial. With a view to their commercial value in this country, extensive numbers are propagated and distributed in localities where it is presumed they will succeed.

The greenhouses of the department ought to be materially enlarged; they are at present altogether too small for the present imperative needs of the department, to say nothing of prospective demands, which are too important to be overlooked.

The arboretum, which was commenced several years ago, has also been arrested in its completion; no new additions, of any moment, have been made for the past two years. This is much to be regretted. The great amount of attention that is justly directed to the planting of forests is measurably assisted by the opportunities afforded in making appropriate selections from observations of the growing plants where a criterion can be reached as to their comparative rapidity of growth, and their suitableness in other respects for particular uses in particular localities. The collection is claimed to be the best assortment of trees that is to be found in the country, comprising both native and foreign kinds, so arranged as to give the greatest opportunities for comparison of their respective values, whether in regard to purposes necessary for the amelioration of climates, the production of fuel, or for use in the arts and constructive economy.

In the *Botanical Division*, which includes the formation of a herbarium for systematic study and illustration of the vegetable kingdom, there has been a favorable state of progress. Several thousand specimens of plants have been added to the herbarium, which is gradually becoming what it ought to be, a complete representation of the vegetable productions of the United States, and incidentally of other countries. The collection has been cramped for want of sufficient room, but provision has now been made to enlarge the space devoted to this purpose.

The following points are kept in view in this division, viz:

1st. The improvement of the herbarium by the addition of new species as rapidly as the means provided will allow.

2d. The replacement of defective and imperfect specimens by good and characteristic ones.

3d. The distribution of duplicate specimens to institutions of learning, and particularly to our agricultural colleges.

A full and complete herbarium of American plants at the seat of government is a necessity, not only in a scientific point of view, but in order properly to answer the numerous questions of a practical and economic character which are daily presented to this department as to the name, nature, and properties of plants from all parts of the country.

The source of supply of specimens has been mainly the collections of the various scientific surveys of the government. If proper regulations are secured, the supply through this channel may be largely increased both in amount and quality, and our means of supplying institutions of learning be greatly enlarged. During the year just past only one addition to the herbarium has been made by purchase, viz., that of a collection of some 600 species of the plants of Southern California and Arizona. During the late Centennial Exposition we became indebted to various

foreign nations for contributions to our herbarium and museum, and an exchange of contributions was earnestly desired by such foreign nations of American productions, especially of our native forest-woods. We have, during the past year, responded to these desires by the following distributions:

To the Royal Botanic Garden at Kew, England, one set of specimens, consisting of four boxes, each of about 150 pounds weight.

To the Imperial Botanic Garden, St. Petersburg, one set of boxes.

To the Museum National de Rio de Janeiro, Brazil, one set of four boxes; also one box of botanical specimens.

To the Colonial Museum, Melbourne, Australia, two boxes of wood-sections.

To the Tokio Museum, Tokio, Japan, two boxes of wood-sections and one box of 400 species of plants.

To the Portuguese Government, two boxes of wood-sections and one box containing about 400 species of botanical specimens.

To the Spanish Government, through J. Jordena, of Morera, Spanish commissioner on forestry, one box of botanical specimens, chiefly of the forest-trees of the United States.

To the Adelaide Museum, Adelaide, South Australia, one box of botanical specimens, embracing about 600 species.

In our own country the following distributions have been made:

To Harvard University, one set of wood-sections.

To Saint Louis Academy of Sciences, one set of wood-sections.

To Yale Scientific School, one set of wood-sections.

To Cornell University, one set of wood-sections.

To Illinois Industrial University, one set of wood-sections.

To the Park Commission of Baltimore, one set of wood-sections.

To the Philadelphia Permanent Exhibition, one set of wood-sections.

In addition to these distributions, we have sent packages of plants to Wesleyan University, Bloomington, Ill.; to D. C. Eaton, professor of botany, Yale College, Conn.; to the normal school, Millersville, Pa.; and several packages to individuals, in exchange.

The *Entomological Division* has, as usual, been employed in answering a large number of letters in regard to names, habits, and especially the remedies now in use for the most destructive of our insect pests.

Among these have been a number of inquiries from foreign governments and private individuals in foreign lands in regard to the "*Phylloxera*," or grape-root gall-louse, and the "*Doryphora decem-lineata*," or Colorado potato-beetle, which insect has already crossed the ocean. The western grasshopper, "*Caloptenus spretus*," which was feared in the earlier part of the season, has done little damage comparatively, and but few letters were received concerning it.

Notes have been made on the habits of insects reared at the department for determination as to their habits.

The cabinet has been augmented by the addition of two or three small collections, principally from the West.

The Centennial collection of economic insects, arranged with regard to their injury or benefit to particular farm crops or products, has been displayed in the cabinet-rooms, making an attractive and instructive exhibition.

No new insects especially injurious to vegetation have been added during the year to the already long list.

The collection of birds destructive to agriculture or beneficial by destroying insect-foes has been relabeled and renamed according to the latest authorities. This collection, accompanied by a series of boxes containing the contents of the stomachs of the birds, is intended to comprise a few of our noxious and beneficial kinds, as a guide to the farmer to show the species which should be especially preserved.

A new gallery has been added to the museum hall, giving about 3,000 square feet of additional floor-space. The cases used by the department at the Centennial Exhibition have been placed in position here. These have been thoroughly renovated, and furnished with new shelving where required, to accommodate the large additions to the museum that were collected for exhibition in Philadelphia, as well as the still larger collections of agricultural products from the Centennial presented by foreign governments. The foreign donations have been unpacked as far as possible, and the cases in the new gallery filled with the specimens.

Many articles still remain unpacked for the want of funds necessary to purchase proper materials for their exhibition.

In view of the fact that it is almost an impossibility to keep insects from grain and wool samples in bulk for any great length of time, even when in bags, it is desirable that an appropriation be made as early as possible, that the specimens may be put beyond the reach of noxious insects and placed in the museum hall.

The work of cataloguing the specimens has commenced, there having been no previous catalogue. The Centennial Exhibition enabled the department to complete its collections more fully, and as the museum has more than doubled in size and in number of specimens, a catalogue becomes a necessity.

The *Chemical Division* has been employed in—

1. Continuation of examination of bat-guanos from the Southern States.
2. Analyses of shell-marls.
3. Investigation of American sumac: (*a*) To determine the best time during the season for collection to secure the highest percentage of tannic acid; (*b*) the causes producing the wide difference in the market-values of the American and Sicilian products, and a ready and sufficient means for their removal; (*c*) percentage of tannic acid in samples taken from the various stages of the process employed in its preparation for the market.
4. Investigation of the natural causes which may modify the supply of mineral nutrition to plants, and their influence upon the production of mildew and rot.

5. Examination of roots for the determination of the presence or absence in them of the so-called vegetable pepsin.

6. Examination of beets for the determination of the percentage of sugar they contain.

The continued examination of bat-guano has afforded results confirming those obtained by the former analysis and proving the wealth of native fertilizing material existing in the South. Indeed, calculations based upon the reported extent of the deposits and the proportion of valuable constituents they are found by analyses to contain, show the aggregate value of this material that may be considered in sight to amount to about $20,000,000. Surely Southern cultivators need no urging to induce them to take advantage of these stores of fertility for their poor or exhausted soils.

The analyses of shell-marls have been such as the time that could be allotted to them would allow, and were confined entirely to the mere estimation of carbonate of lime, phosphoric acid, and potassa they contain.

The results obtained in the investigation of American sumacs are of an exceedingly satisfactory character, and may be summarized as follows:

1st. The time for collection to secure the highest percentage of tannic acid is during the month of July.

2d. The wide difference in the market-values of the American and Sicilian products is due to the yellow coloring matter contained in the former.

3d. In order to get rid of this troublesome matter, and secure a quality of sumac of technical value equal to the Sicilian, the leaves should be collected during the month of June. Upon these results may be based rules for the classification of sumac in the markets, so that the June collections may be applied to the tanning of delicately-colored leathers, while the July collections may be employed in the manufacture of dark-colored leathers and for dying dark-colored goods. By this means the American product, which is obtained from an entirely spontaneous growth upon lands that would otherwise be worthless, may find much wider appreciation and thus prevent the large importations of the foreign product, the cost of which annually aggregates about $700,000 to consumers.

The investigation relating to the natural causes in the soil tending to the production of mildew and rot in plants has afforded results which, before they can be accepted, must be duplicated. The experiments made, which were entirely of a preliminary character, proved exceedingly interesting, and have opened up a fruitful field for extended study and research.

The increasing interest in the production of sugar-beets and the manufacture of sugar from them, and the earnest endeavors to bring about a permanent establishment of this important industry throughout the United States, has led to the estimations of the sugar percentage found in beets from crops grown in various localities, and most of them have proven the capability of American soil to produce beets of good quality.

The work projected and partly under way consists of—

1st. Further investigations of physical causes which may influence the production of mildew and rot.

2d. Experiments on the industrial application of the coloring matter of the coleus plant to textile fabrics.

3d. Examination of the root of the lignum-vitæ for the determination of its value as a detergent for cleansing textile fabrics.

4th. Analysis of the various native Southern grasses for the determination of their value for cattle-food.

5th. Analysis of specimens from a natural deposit in Maryland, supposed to contain large quantities of phosphate of lime.

6th. Examination of certain Florida soils.

7th. An examination of the American wheats, for the determination of their value for the manufacture of flour that will not readily ferment in warm climates, is under consideration, and will be prosecuted whenever the chemical force of the department will admit. With but one chemist and one assistant, and the constantly-increasing miscellaneous work that must be attended to, this now appears almost hopeless.

During the present year the *Microscopist* of the department visited some of the principal cranberry districts of New Jersey, for the purpose of investigating the causes of diseases which for some years past have seriously affected cranberry-vines in that State, causing much of the fruit to prematurely decay. He also visited localities in this State where the grape is extensively grown, and made a partial microscopical investigation for the purpose of determining the cause of rot in the Concord grape.

During the season of harvesting the attention of the department was called to the fact of the partial failure of the wheat-crop in several localities in Northumberland County, Virginia. As this failure could not be traced to any of the known causes of diseases which affect this cereal, the Microscopist was directed to proceed to the locality and make an examination of the plant and soil with a view of ascertaining the cause of such failure. Such facts as were elicited in these various investigations have been submitted to the department.

The *Statistical Division* has been employed in—

1st. The record and tabulation of foreign and domestic statistics of agriculture, derived from national and State departments and the various grades of rural societies and experimental schools.

2d. The collection of statistics of distribution of the products of agriculture, the current price of such products in primary markets, and the cost of transportation and exchange.

3d. Statistical analysis of such information and deductions illustrative of the causes or change in production, its economic tendencies, and comparative profits.

4th. An original crop-reporting system, including a corps of correspondents or reporters in the principal counties.

The work of the past year has been obstructed by a reduction of appropriations, which have been insufficient for the payment of the

usual labor of record and compilation in the office. The demand for information by members of Congress, boards of trade, agriculture, and rural and technical writers has been met as fully as possible with this lack of facilities.

The crop records of the present year have been of unusual interest and importance. At the outset complaints were made of the lateness of the planting season and slow growth of corn on account of an excess of rain and a comparatively low temperature. Early reports were speedily followed by accounts of general and rapid improvement; prompt replanting of wet areas and cleaner cultivation; and later returns indicated higher condition than in 1876, promising, with an increase of acreage, at least 50,000,000 bushels, or a crop not less than 1,340,000,000 bushels, the largest ever grown. The records of this crop illustrate the importance of yearly estimates, which show that the average yield ranges from 20 bushels in a poor crop to 30 in a large one, from 768,000,000 bushels in 1867 to 1,340,000,000 in 1875, and that the smallest crop yields the greatest aggregate in money. The price per bushel has ranged from 79.5 cents in 1867 to 37 cents in 1876, while the average for ten years has been 58.2 cents, and the average yearly aggregate $538,442,000. The present is the third large crop in succession following small crops, but the value of 1,300,000,000 bushels differs only in a slight degree from the total valuation of a crop of 900,000,000 bushels.

The wheat-crop of the present year has been promising in a high degree during the entire season. Fears of grasshopper invasions were early dispelled, except in a few counties in Minnesota. The losses from winter-killing, the fly, chinch-bug, grasshoppers, rust, smut, &c., have this season been far less than usual. The heaviest production is in the section of the lightest yield last year (the Northwestern or spring-wheat States), whose product fell off 36,000,000 bushels. The aggregate in Wisconsin, Minnesota, Iowa, and Nebraska is double that of last year, and nearly 20,000,000 bushels greater than in 1875. The entire crop promises to exceed that of last year by 70,000,000 bushels, leaving 100,000,000 bushels for exportation, with a surplus remaining above the actual requirement of consumption. Other crops have generally been good. A comparison of the crops of the past three seasons is given, as follows, the figures for the present year being preliminary and subject to revision in completing and perfecting the estimates of the year:

Crops.	1877.	1876.	1875.
	Bushels.	*Bushels.*	*Bushels.*
Corn	1, 340, 000, 000	1, 283, 827, 500	1, 321, 069, 000
Wheat	360, 000, 000	289, 356, 500	292, 136, 000
Rye	22, 000, 000	20, 374, 800	17, 722, 100
Oats	390, 000, 000	320, 884, 000	354, 317, 500
Barley	35, 000, 000	38, 710, 500	36, 908, 000
Potatoes	140, 000, 000	124, 827, 000	166, 877, 000

Among the "industrial crops," cotton, the most prominent, promised 4,500,000 bales in October, but the weather has since been unfavorable,

and may lead to a smaller percentage of production. A bad picking-season to the end of December might reduce the product half a million bales.

The tobacco-crop promises to be a large one, and may reach a product of 440,000,000 pounds, about 60,000,000 above the estimated product of last year.

The season has been unfavorable for fruit of most kinds. The main crop, that of apples, is a comparative failure, nowhere found in abundance, greatly reduced in yield, and high in price. Other fruits are also reduced in yield. The grape-crop suffered in an unusual degree from rot, and the wine product will be reduced in the affected districts.

The products of the dairy are abundant, and the prices are fairly remunerative. A tendency to enlargement of this industry in the West is manifest in a marked degree.

There has been a fair prospect for an increase in the product of sugar over that of last year, but in consequence of bad weather for harvesting and securing the cane, it is too early to say whether the yield will be equal to that of last year.

The distribution of a miscellaneous assortment of seeds to the farmers on the frontier, whose crops were destroyed by the locust or grasshoper, was of the greatest benefit to those poor and destitute people, who were thus enabled to remain on their farms, and to secure enough of the fruits of the earth to eke out a living until the terrible scourge had passed away, or another season had arrived with better hopes of successful culture. In the planting of trees, and the consequent increase of insectivorous birds, as well as in the ingenious devices which have been adopted by the farmers of Minnesota and Kansas the past year, the most efficient means will be found of keeping under control a pest which has been more terrible than "an army with banners" since history has had a record.

Perhaps the earliest account of any appearance of the grasshopper west of the coasts of Europe or Africa is that given in the History of Jamaica, by Sir Hans Sloane, in which a life-size drawing is given of the locust or grasshopper that fell on the deck of a vessel many leagues from land. The insect here described was of a species now known as the Barbary locust, and was larger than that which has ruined so many of the farmers of the West during the past five years, and the ravages of which, we may expect, will be repeated from time to time until the knowledge and ingenuity of our people shall master the secret of their birth and habits, and control the breeding-grounds, or destroy the predaceous hordes before they can have time to work fatal mischief to the crops.

The following tabular statement will exhibit the extent of this distribution to the grasshopper districts in detail:

Tabular statement showing the quantity and kind of seed issued from the Department of Agriculture to States and Territories ravaged by the grasshoppers, under special appropriation of $20,000 of March 3, 1877.

Description of seed.	Nebraska.		Minnesota.		Kansas.	
	Senators and members.	Miscellaneous.	Senators and members.	Miscellaneous.	Senators and members.	Miscellaneous.
Vegetable .... papers..	121, 200	18, 550	321, 500	12, 185	135, 400	8, 735
Wheat .... quarts..	....	....	400	68	....	2
Barley .... do....	....	2	600	82	....	....
Buckwheat .... do....	....	....	....	....	314	2
Corn .... do....	1, 500	10	2, 044	40	1, 080	10
Pease .... do....	....	....	2, 060	8	....	....
Sugar-beet .... do....	....	2	600	....	16	6
Mangel-wurzel .... do....	....	2	600	....	16	6
Grand total	122, 700	18, 565	327, 804	12, 383	136, 826	8, 761

Description of seed.	Iowa.		Montana.	Dakota.		Colorado.	Total.
	Senators and members.	Miscellaneous.	Member.	Member.	Miscellaneous.	Senators.	
Vegetable .... papers..	198, 720	19, 890	7, 500	3, 000	58, 075	27, 135	931, 890
Wheat .... quarts..	....	10	....	....	....	....	480
Barley .... do....	....	....	....	....	2	....	686
Buckwheat .... do....	....	....	....	....	....	....	316
Corn .... do....	....	10	....	2	....	1, 000	5, 696
Pease .... do....	444	....	....	....	....	....	2, 512
Sugar-beet .... do....	350	....	....	2	....	....	976
Mangel-wurzel .... do....	350	....	....	....	....	....	974
Grand total	199, 864	19, 910	7, 500	3, 004	58, 077	28, 135	943, 530

In the *Seed Division*, which embraces the packing and distribution of seeds, the following tabular statement will show the extent and description of seeds distributed during the past year:

Tabular statement showing the quantity and kind of seed issued from the Department of Agriculture, under the general appropriation, from July 1, 1876, to June 30, 1877, inclusive; also amount issued under special appropriation to sufferers by grasshopper ravages.

Description of seed.	Varieties.	Senators and members.	Agricultural societies.	Statistical correspondents.	Miscellaneous.	Grasshopper ravages.	Total.
Vegetable .... papers..	326	221, 070	159, 100	235, 885	263, 155	931, 890	1, 811, 100
Flower .... do....	220	148, 770	220	155	153, 250	....	302, 395
Herb .... do....	9	150	....	....	235	....	385
Tree .... do....	15	306	398	315	2, 026	....	3, 045
Field seeds.							
Wheat .... quarts..	7	14, 454	16, 304	16, 004	5, 484	480	52, 726
Oats .... do....	5	5, 976	10, 982	10, 104	3, 554	....	30, 616
Barley .... do....	4	2, 416	8, 558	8, 154	696	686	20, 510
Rye .... do....	1	2, 408	....	418	246	....	3, 072
Buckwheat .... do....	1	270	2, 476	6, 146	432	316	9, 640
Corn .... do....	4	2, 230	3, 174	3, 758	759	5, 696	15, 617
Pease .... do....	1	16	....	....	34	2, 512	2, 562
Clover .... do....	4	1, 542	48	22	1, 093	....	2, 705
Grass .... do....	5	2, 492	1, 572	3, 466	2, 870	....	10, 400
Sugar-beet .... do....	3	2, 914	469	244	253	976	4, 856

Tabular statement showing the quantity and kind of seed issued, &c.—Continued.

Description of seed.	Varieties.	Senators and members.	Agricultural societies.	Statistical correspondents.	Miscellaneous.	Grasshopper ravages.	Total.
Mangel-wurzel .... quarts..	3	2, 222	1, 124	859	216	974	5, 395
Rice .... do....	1	16	....	....	14	....	30
Sorghum .... do....	1	84	....	....	234	....	318
Millet .... do....	1	122	....	179	12	....	313
Broom-corn .... do....	1	32	138	400	81	....	651
Vetches .... do....	1	....	....	....	11	....	11
Rape .... half pints..	1	6	....	....	2	....	8
Tobacco .... papers..	4	42, 562	100	10	2, 726	....	45, 398
Opium poppy .... do....	1	200	....	....	182	....	382
Chufa .... do....	1	1, 540	....	....	3, 681	....	5, 221
Textiles.							
Cotton .... quarts..	4	682	1, 570	2, 627	581	....	5, 460
Jute .... do....	1	16	....	398	88	....	502
Hemp .... do...	1	....	....	....	4	....	4
Flax .... do....	1	8	....	....	....	....	8
Ramie .... papers..	1	....	....	....	144	....	144
Grand total	......	452, 504	206, 233	289, 144	442, 063	943, 530	2, 333, 474

This distribution, as will be seen, extends through the fiscal year ending with June, 1877, and includes, therefore, the fall planting of last year and the spring planting of the present year. While this distribution is believed to have been in many respects of great value to the country, it was found to possess some features that were not wholly legitimate. I have accordingly introduced some changes in the method of distribution, which will conform to the organic law, and result in a more beneficial working of the system.

It will be seen from the above table that the distribution embraced very many common vegetable and flower seeds, and finding no authority in the provisions of the organic law of the department for the distribution of these, or indeed any other description of seeds than those which were "new and valuable," I deemed it my duty to limit the distribution to such seeds as were clearly within the meaning of the law, having due regard to differences of climate and other agricultural conditions of the various sections of the country.

It will be observed, also, that a large portion of the seeds was issued to "miscellaneous" applicants, necessarily with little or no knowledge on the part of the department as to the claims of such applicants as *agriculturists*. This, it was believed, led to misapplication, abuse, and even fraud, in the use of seeds, and a more careful scrutiny has, in consequence, been exercised by confining the distribution to agricultural associations and colleges, permanent correspondents and agents of the department, and to such individuals as were known to be agriculturists, as distinctly defined by the law, which designates such persons, and such only, as the recipients of the bounty of the department With the latter object in view, measures were taken through members of Congress to ascertain the names of such farmers in the different Congressional districts as from their intelligence and experience would afford the best

security for thorough, careful, and exhaustive trials of seeds under varied circumstances of soil and climate.

The changes in general which were conceived to be demanded for the more successful working of the department, and for bringing its action as far as possible into conformity with the terms of its organization, are indicated in the following circular-letter, which I took an early occasion to issue:

DEPARTMENT OF AGRICULTURE,
Washington, D. C., July 30, 1877.

The following sections of the Revised Statutes of the United States embrace all the provisions of law in relation to the distribution of seeds by this department:

"SECTION 520. There shall be at the seat of government a Department of Agriculture, the general design and duties of which shall be to acquire and to diffuse among the people of the United States useful information on subjects connected with agriculture, in the most general and comprehensive sense of that word, and to procure, propagate, and distribute among the people *new and valuable* seeds and plants.

"SEC. 526. The Commissioner of Agriculture shall procure and preserve all information concerning agriculture which he can obtain by means of books and correspondence, and by practical and scientific experiments, accurate records of which experiments shall be kept in his office, by the collection of statistics, and by any other appropriate means within his power; he shall collect *new and valuable* seeds and plants; shall test, by cultivation, the value of such of them as may require such tests; shall propagate such as may be worthy of propagation, and shall distribute them among agriculturists.

"SEC. 527. The purchase and distribution of seeds by the Department of Agriculture *shall be confined* to such seeds as are *rare and uncommon* to the country, or such as can be made more profitable by frequent changes from one part of our own country to another; and the purchase or propagation and distribution of trees, plants, shrubs, vines, and cuttings shall be confined to such as are adapted to general cultivation, and to promote the general interests of horticulture and agriculture throughout the United States."

The Commissioner finds no authority in these provisions of law for the distribution of any other garden and field seeds than those which are "new and valuable." It is obvious that the decision as to what is new and valuable must depend mainly upon considerations of soil and climate. What may be well known and comparatively worthless in one section of the country may be new and valuable in another. What is absolutely new and untried will of course require the test of experience to prove its value and ascertain its adaptability to any given section. It is plain, also, that the law does not contemplate the purchase and dissemination of such seeds as may readily be procured at the many seed establishments of the country.

It will be the aim of the department, in this view of its duties, to distribute as widely as possible such new and valuable and improved varieties of seeds as may be adapted to general cultivation, or to different sections of the country, so as to meet the various demands of our wide-spread population, and conduce to the interests of agriculture throughout the country. This distribution will be made through agricultural organizations and such individuals as may desire to enter upon a series of experiments, and who may seem to afford the best security for thorough, careful, and exhaustive trials of seeds in different parts of the country, and under varied circumstances of soil and climate. As the desired results of such a distribution can only be attained by repeated and careful experiments, the department will expect, as a condition of distribution, assurance of such a trial as will afford a satisfactory test. Blanks for making these returns will be sent with the seed, and when returned, carefully filled up, will entitle the person favored by the department to future consideration.

WM. G. LE DUC,
Commissioner of Agriculture.

So far as there has been opportunity to learn the public opinion, this circular has met with universal approval; and it is now hoped that by careful consideration of the condition of the soil and climate of different localities, and of the adaptability of seeds to each locality, a more beneficial and less wasteful dissemination of seeds will be made.

The *correspondence* of this department, both foreign and domestic, is increasingly valuable, in furnishing interesting and useful information as to the progress of husbandry at home and abroad. There is a continued and growing desire on part of the numerous governments of this continent, and other quarters of the world, with which a system of international agricultural exchanges has been established, to co-operate with the department, effecting a mutual interchange of agricultural and horticultural information, and of such seeds and plants as are indigenous to the respective countries; and among the farmers and planters of our own country there is an earnest spirit of inquiry as to the developments of agricultural industry, and the important interests which it is the object of the department to promote.

The following table exhibits, in a condensed form, the appropriations made by Congress for this department, the disbursements, and the balances covered into the Treasury, for the fiscal year ending June 30, 1877:

Title of appropriation.	Amount appropriated.	Amount disbursed.	Amount unexpended.
Salaries	$67,836 96	$67,806 19	$30 77
Collecting statistics	10,000 00	10,000 00	
Purchase and distribution of seeds	65,000 00	62,551 83	*2,448 17
Experimental garden	5,000 00	5,000 00	
Museum and herbarium	2,000 00	2,000 00	
Furniture, cases, and repairs	2,000 00	2,000 00	
Library	1,000 00	755 64	244 36
Laboratory	1,300 00	1,300 00	
Contingent expenses	10,000 00	9,993 97	1 03
Postage	4,000 00	3,462 37	537 63
Printing and binding	9,000 00	9,000 00	
Improvement of grounds	6,550 00	6,550 00	
Distribution of seeds in States ravaged by grasshoppers	20,000 00	20,000 00	
Total	203,686 96	200,425 00	3,261 96

* Two thousand dollars of this balance to be paid as compensation for report on forestry, not yet presented.

It is shown by a recent statement made from the records of the Treasury Department that the total expenditures of the Department of Agriculture from 1839 to 1877, inclusive, amount to $3,366,114.37. From this amount should be deducted $100,000 appropriated in 1867 for the purpose of enabling the Commissioner of Agriculture to erect a department building, and the further sum of $50,000 appropriated for the printing of the annual reports of the department for the years 1872 and 1873, and erroneously charged to the current annual expenses of the department for those years. Deducting these two items from the above amount, and it leaves the sum of $3,216,114.37 as the aggregate amount appropriated during the existence of the government for the promotion of agriculture. The utter insignificance of this sum becomes apparent when compared

with the amounts appropriated for the maintenance of other departments of the general government. Dividing the total amount appropriated by the number of years during which these appropriations have been made, and it gives the small sum of $84,634 as the average annual expenses of the department. When it is remembered that the last census established the fact that one-half the population of the United States is either directly engaged in agricultural pursuits, or is wholly dependent upon them for support, this sum becomes still more insignificant as an appropriation for fostering and promoting so vast an interest.

The following appropriations for the years named will be sufficient to illustrate the difference in the amounts appropriated for the various departments of the general government:

Departments, &c.	1877.	1878.
Department of State	$1,188,797 50	$1,147,660 48
Treasury Department	14,837,357 47	12,784,718 94
War Department	7,337,675 02	1,983,902 73
Military establishments	29,651,769 86	....
Navy Department	388,598 24	365,966 67
Naval establishments	12,739,790 90	14,536,432 90
Department of the Interior	3,418,432 89	3,450,627 14
Indian Affairs	5,147,897 63	4,877,990 00
Post-Office Department	567,860 29	936,549 20
Postal service	5,917,498 00	2,939,725 00
Department of Justice	385,876 20	412,622 05
Department of Agriculture	174,686 96	208,640 00

Under an act of Congress approved August 16, 1876, the Commissioner of Agriculture was directed to appoint some man of approved attainments, who was practically well acquainted with methods of statistical inquiry, and who had evinced an intimate acquaintance with questions relating to the national wants in regard to timber, to prosecute investigations and inquiries, with a view of ascertaining the annual amount of consumption, importation, and exportation of timber and other forest products; the probable supply for future wants; the means best adapted to their preservation and renewal; the influence of forests upon climate, and the means that have been successfully applied in foreign countries, or that may be deemed applicable in this country, for the preservation and restoration or planting of forests; and to report upon the same to the Commissioner of Agriculture, to be by him, in a separate report, transmitted to Congress.

Under this act my predecessor appointed Dr. Franklin B. Hough, of Lowville, N. Y. Since that appointment, Dr. Hough reports that he has diligently prosecuted these inquiries, and during the last summer traveled several thousand miles through the Western States and Territories, where the necessities of tree-culture are most severely felt, and in which a lively interest has been manifested in every question that has a bearing upon this vital interest. He has issued a series of circulars of inquiry, and has engaged in extensive correspondence both in this country and in Europe, receiving from the principal governments of the latter their

most recent reports, and from leading foresters the latest results of experimental observation.

The report soon to be presented to Congress will give the results of these inquiries and experiments, and it is to be hoped will call the attention of our national representatives to the importance of the subject, and the necessity of encouraging and aiding a branch of agricultural industry so vital to the health and welfare of our people.

The need of a *general and complete index* to the thirty-seven volumes of the Annual Reports on Agriculture, embracing the reports of the Patent Office for 1838, and from 1841 to 1861 inclusive, and of this department from 1862 to 1876 inclusive, is constantly felt by all having occasion to refer to these records of our agricultural history, or who desire to profit by this store of experiences pertaining to that portion of our national development. In consequence of this want there has been for a considerable period in preparation an index of subjects, of 400 pages of manuscript, containing over 20,000 references, and also an index of scientific terms and of the names of the animals, birds, fishes, and insects, making an addition of 370 pages of manuscript.

These, if printed together, would make an octavo volume of 300 pages, or 200 pages if printed in double column. These are now complete, except for the volume of 1876, and this is in the course of preparation, and can be ready for the press with the general index before the other portions are put in type.

Which is respectfully submitted, by your obedient servant,

WM. G. LE DUC,
Commissioner of Agriculture.

THE CANE-SUGAR INDUSTRY.

(Special Report No. 1.)

Soon after induction into his present office, the attention of the Commissioner was directed to the condition of the sugar interest in the United States.

The facts elicited in this examination are thought to be of sufficient importance to warrant publication at this time, with the hope of awakening an interest in the subject commensurate with its great value to the whole country.

In view of the fact that the sugar-lands of Louisiana are unsurpassed in natural fertility and productiveness, and that in years preceding the war of the rebellion they furnished the country a very much larger proportion of its saccharine supply than since the conclusion of the strife, there is no satisfactory reason why the United States should continue to pay annually millions of dollars to foreign nations for articles of consumption that might readily be supplied by domestic producers. The production of sugar in Louisiana having fallen off immensely,* it was deemed advisable to obtain the views of planters upon the general subject, but more especially in relation to the particular causes of decline in the culture, and the best methods and appliances through the employment of which the industry might be restored, and, if practicable, still further advanced. The following letter was therefore addressed to leading planters of Louisiana:

DEPARTMENT OF AGRICULTURE,
Washington, July 28, 1877.

DEAR SIR: It is earnestly desired, so far as it is possible, by the aid of the department, to give encouragement to an increase in the production of sugar, that we may save the millions of dollars that annually go elsewhere for importations. We have a soil and climate adapted to the growth of cane inferior to none, and should, in fact, if proper attention were given to this industry, supply the markets of the world with sugar.

Will you give your attention and valuable experience to this subject and advise me how this department can best promote this interest?

Very respectfully,

WM. G. LE DUC,
Commissioner.

The large number of replies received to this letter and the warm interest manifested in the subject by the writers give much satisfaction to the department, and it is believed that substantial good will follow from the stimulation of special inquiry among the planters themselves.

In this correspondence, as it relates to the decreased production of sugar in Louisiana and the possibilities of the reinvigoration of the industry, the ground is very fairly, if not thoroughly, traversed. The causes of lessened production are clearly stated, and the remedies, to some extent, foreshadowed. The writers being for the most part land proprietors and planters, some of them of large experience, their statements and sugges-

* Bouchereau institutes a comparison between the crop of 1861-'62 and that of 1876-'77, which shows the former to have been 459,410 hogsheads, or 528,321,500 pounds of sugar, and the latter 169,331 hogsheads, or 190,672,570 pounds.

tions may be considered reliable and entitled to respectful consideration, to the extent that these relate to an industry with which they must be supposed thoroughly and accurately familiar.

CONSUMPTION OF SUGAR IN THE UNITED STATES.

The following tables were compiled by the New York Shipping List from governmental and commercial reports, by adding to the imports of each year the amount left over from the previous year and deducting the surplus at the close. To this is added a reliable estimate of the amount of domestic sugar and molasses produced within the year, deducting the quantities exported. This process gives a close approximation to the actual consumption. These figures are republished, with indorsement, by Mr. L. Bouchereau, in his excellent reports on sugar production in Louisiana. The importation of sugar and molasses on the Pacific coast is not given by the above authority, and cannot be made out from the Treasury reports in calendar years, for the reason that these reports conform only to fiscal years. Local statisticians at San Francisco give the importations for three years, omitting fractions, as follows: 1874, 32,425 tons; 1875, 22,850 tons; 1876, 30,882 tons.

Consumption of sugar in the United States.

Years.	Total consumption.	Imported.	Domestic.
	Tons of 2,240 lbs.	*Tons of 2,240 lbs.*	*Tons of 2,240 lbs.*
1860	415, 281	296, 250	119, 031
1861	363, 819	241, 420	122, 399
1862	432, 411	241, 411	191, 000
1863	284, 308	231, 398	52, 910
1864	220, 660	192, 660	28, 000
1865	350, 809	345, 809	5, 000
1866	391, 678	383, 178	8, 500
1867	400, 568	378, 068	22, 500
1868	469, 533	446, 533	23, 000
1869	492, 899	447, 899	45, 000
1870	530, 692	483, 892	46, 800
1871	633, 314	553, 714	79, 600
1872	637, 373	567, 573	69, 800
1873	652, 025	592, 725	59, 300
1874	710, 369	661, 869	48, 500
1875	685, 352	621, 852	63, 500
1876	638, 369	561, 369	77, 000

The importations of cane-molasses, in the same years, are shown as follows:

Years.	Total consumption.	Imported.	Domestic.
	Gallons.	*Gallons.*	*Gallons.*
1860	47, 318, 877	28, 724, 205	18, 594, 672
1861	40, 191, 556	20, 383, 556	19, 808, 000
1862	62, 668, 400	25, 650, 400	37, 018, 000
1863	37, 569, 088	26, 569, 088	11, 000, 000
1864	32, 410, 325	28, 582, 325	3, 828, 000
1865	35, 185, 038	34, 335, 038	850, 000
1866	45, 140, 110	43, 840, 110	1, 300, 000
1867	49, 776, 465	46, 776, 465	3, 000, 000
1868	55, 957, 969	52, 587, 969	3, 370, 000
1869	54, 361, 092	47, 961, 092	6, 400, 000
1870	49, 323, 171	42, 723, 171	6, 600, 000
1871	52, 065, 784	41, 165, 784	10, 900, 000
1872	53, 695, 203	42, 995, 203	10, 700, 000
1873	51, 485, 526	41, 985, 526	9, 500, 000
1874	48, 206, 257	39, 506, 257	8, 700, 000
1875	58, 608, 734	46, 418, 734	12, 190, 000
1876	48, 809, 504	36, 456, 504	12, 350, 000

From which tables it appears that, in the years named, the United States produced less than 13 per cent. of the cane-sugar it consumed, and little more than 21 per cent. of its molasses consumed.

The leading sources of our foreign supply are exhibited below. Twenty-one other nations supply the remainder, which is about 3 per cent. of the whole amount:

Countries.	Quantity.	Value.
	Pounds.	
Cuba	1,008,413,671	$41,039,048
Spanish possessions	110,445,768	3,572,400
Porto Rico	70,155,045	2,610,418
French West Indies and Guiana	49,687,265	1,751,478
Brazil	40,010,416	1,329,938
Dutch East Indies	26,187,830	1,052,953
British West Indies and Honduras	23,212,168	844,144
British Guiana	21,865,691	912,101
Sandwich Islands	20,978,374	1,051,987

Consumption per capita.—As the foregoing tables do not include the Pacific States, their population is deducted in obtaining the consumption *per capita*. The increase of population in the States east of the Rocky Mountains, during the ten years from 1860 to 1870, was at the rate of 21 per cent. for the whole decade, or over 2 per cent. per annum compounded.

Equalizing this increase, and allowing for the destructive influence of the years of warfare, the following rates of consumption *per capita* are arrived at, viz: 1860, 29.58 pounds; 1861, 26.14; 1862, 30.73; 1863, 20.05; 1864, 15.37; 1865, 24.08; 1866, 26.35; 1867, 26.17; 1868, 29.78; 1869, 30.35; 1870, 31.76.

The average increase of population per decade prior to the war was between 33 and 35 per cent., which would give nearly 3 per cent. per annum compounded. During the earlier years of the current decade, this rate was fully kept up by a very large foreign immigration. An increase of 3 per cent. is allowed for each year up to 1874, and 2½ per cent. for 1875 and 1876. This reduction is allowed on the ground of the falling off in foreign immigration. With the resulting figures of population as divisors, the estimates *per capita* of the current decade are as follows, viz: 1871, 36.80 pounds; 1872, 35.96; 1873, 35.71; 1874, 37.54; 1875, 35.39; 1876, 32.

With various fluctuations, the above figures show a steady increase in the consumption *per capita* up to 1874, the year in which our present commercial stringency was inaugurated. Each of the two subsequent years shows a marked reduction in the consumption, resulting from the decreased purchasing-power of the people.

The marked decline in consumption *per capita* during the late civil war is due, first, to the destruction of home production. Prior to the occupation of Louisiana by the Union armies, sugar-planters made great efforts to supply the Southern States, but the operations of war gradually restricted and the emancipation of the slaves finally prostrated this home production. Secondly, the blockade of Southern ports cut off the Southern people from the foreign market and prevented the import of supplies. Consumption was measurably restricted to the loyal States, but as the Union armies advanced a wider scope of trade was given and the aggregate imports enlarged. The close of the war showed a sharp advance from 15.37 pounds *per capita* in 1864 to 24.08 pounds in 1865.

The annual production of sugar and molasses in Louisiana from 1868

to 1876 is shown in the following exhibit. In the former year the industry began to recover from the prostrating effects of the civil war:

Year.	Pounds of sugar produced.			Molasses produced.	
	Brown sugar by old process.	Refined and clarified by vacuum-pans.	Total.	Total gallons.	Gallons per each hogshead of sugar.
1868	81, 506, 093	13, 545, 132	95, 051, 225	6, 081, 907	72
1869	....	....	99, 452, 946	5, 724, 236	65
1870	147, 562, 588	21, 346, 004	168, 878, 592	10, 281, 419	71
1871	126, 649, 952	20, 256, 173	146, 906, 125	10, 019, 958	78
1872	108, 501, 004	16, 845, 489	125, 346, 493	8, 898, 640	82
1873	88, 058, 278	15, 182, 841	103, 241, 119	8, 203, 944	92
1874	110, 856, 363	23, 648, 328	134, 504, 691	11, 516, 828	98
1875	131, 700, 360	31, 717, 710	163, 418, 070	10, 870, 546	75
1876	149, 904, 430	40, 768, 140	190, 672, 570	12, 024, 108	71

Referring now to the reports of the United States Bureau of Statistics, and confining attention to the last three years, we are enabled to present the custom-house exhibits of importations, together with the values thereof:

FISCAL YEAR OF 1874.

Sugar, brown	pounds..	1, 594, 306, 354	$77, 459, 968
Sugar, refined	do....	39, 259	3, 139
Molasses	gallons..	47, 189, 837	10, 947, 824
Melada, sirup, &c	pounds..	106, 952, 236	4, 424, 356
Candy, &c	do....	56, 443	13, 916
Total		....	92, 849, 203

FISCAL YEAR OF 1875.

Sugar, brown	pounds..	1, 695, 726, 353	$70, 015, 757
Sugar, refined	do....	15, 251	1, 202
Molasses	gallons..	49, 112, 255	11, 685, 224
Melada. &c	pounds..	101, 768, 386	3, 313, 597
Candy, &c	do....	76, 816	16, 737
Total		....	85, 033, 517

FISCAL YEAR OF 1876.

Sugar, brown	pounds..	1, 414, 254, 663	$55, 702, 903
Sugar, refined	do....	19, 931	1, 685
Molasses	gallons..	39, 026, 200	8, 157, 470
Melada, &c	pounds..	79, 702, 878	2, 415, 995
Candy, &c	do...	87, 995	18, 500
Total		....	66, 296, 553

From which the fact is derived that the average annual value of imported sugar and molasses for the last three years is $81,393,091.

The large reduction in consumption in 1876, as compared with the three years immediately preceding, is attributable to the economy practiced by the masses on account of the stringency of the times, and the fact that there was an estimated falling off of about 200,000 tons in the sugar-producing countries from the crop of the preceding year, which

caused an average advance of about half a cent per pound in the selling price.

The totals above presented do not, of course, represent the sums that have actually passed into foreign hands for our foreign supply, since, say, two-thirds is returned to the Treasury of the United States as duties.* Nevertheless, even at the present prices of cane-products, the amount that is so exchanged is enormous, and challenges the earnest and immediate attention of those who are anxious to promote our own industries. In view of the demonstrable fact that the capacity of the sugar-belt of the United States is sufficient not only fully to supply domestic needs, but also under proper stimulants to create a trade of export, it would seem gross unwisdom, if not, indeed, criminal neglect, to omit effort in the direction of fostering an interest of so great financial and economic importance. It is, moreover, a plain proposition that to profitably increase the production of one necessary commodity is to divert labor from the overproduction of another, thus adding to the general prosperity. Thus, we find through our correspondents that in most parts of the South the corn and rice fields, and even some of the cotton-areas, are not so remunerative as formerly. Diversity of crops is the requirement, both on account of the soil and the profitable employment of capital and labor. There is no fault found by sugar-planters with the prices received for their products. The profits are indeed extraordinary, even with the scarcity of labor and the unmethodical and crude methods of cultivation and cane manipulation taken into consideration. The immense loss entailed by the unscientific handling of the *bagasse* is referred to in another part of this article. A large planter in Jefferson Parish, whose letter appears in the appendix, demonstrates that on his crop of the present season a profit of from 80 to 100 per cent, is reasonably to be expected on his outlay.

The importation of sugar and molasses is a necessity only because a sufficient supply is not raised at home, and is not, therefore, to be regarded as a trade directly competing with our own product.

THE SUGAR-LANDS.

The authorities describe the sugar-growing region of Louisiana as lying on both sides of the Mississippi River, from about sixty miles below New Orleans to about two hundred miles above, including the lands about many of the bayous, the banks of the Red River, embracing the parishes of Avoyelles and Rapides, and the level lands of Vermillion and Saint Martin; and yet, as was stated in the report of this department for 1873, after an investigation of the subject by its statistician, the average area annually cultivated in sugar-cane in Louisiana did not exceed 150,000 acres, or about half of an ordinary county.† It was at the same time asserted that "if even this small acreage could be brought up to the standard which Mr. Bringier, one of the most intelligent planters in Louisiana, thinks is entirely practicable, the annual yield of the State would exceed 885,000,000 pounds of sugar and 52,500,000 gallons of mo-

*The report of the Bureau of Statistics for 1876 gives the amount of duties on importation of sugar, molasses, &c., at $42,000,000, in round numbers.

A New York commercial authority, referring to the magnitude of the sugar-trade, expresses the opinion that the value of the imported raw sugar sold, duty paid, in the United States the present year, will perhaps exceed $125,000,000, to which amount must be added the additional cost of refining, about $2,000,000. To this must also be added the value of molasses imported, from $50,000,000 to $60,000,000.

†Bouchereau shows that in the season of 1876–'77 there were 104,944 acres of cane-ground, which yielded on an average 1,817 pounds of sugar and 114 gallons of molasses per acre.

lasses, which would equal one-half our annual import of sugar and exceed our import of molasses."

Nevertheless, the sugar limit is not confined to Louisiana. In ten other states cane, with ordinary cultivation and appliances, has been found to give fair returns, while the reports of yields in the gulf regions of Texas give promise of great future results. Much of Florida bordering the gulf coast is indisputably well adapted to profitable sugar-culture. It would be very difficult, if indeed at all practicable, to secure accurate reports of the cane-product outside of Louisiana, in which it is a leading staple carefully noted; but, relying upon the United States census for 1860 and 1870, the following is the exhibit of cane-products in the Southern States in the years 1859 and 1869:

States.	1859.		1869.	
	Sugar.	Molasses.	Sugar.	Molasses.
	Hhds.	*Galls.*	*Hhds.*	*Galls.*
North Carolina	38	12, 494	35	33, 888
South Carolina	198	....	1, 055	436, 882
Georgia	1, 167	546, 749	644	553, 192
Florida	1, 669	436, 357	952	344, 339
Alabama	175	85, 115	31	166, 009
Mississippi	506	10, 016	49	152, 164
Louisiana	221, 726	13, 439, 772	80, 706	4, 585, 150
Texas	5, 099	408, 358	2, 020	246, 062
Arkansas	....	....	92	72, 008
Missouri	402	22, 305	49	....
Tennessee	2	2, 830	1, 410	3, 623
Totals	230, 982	14, 963, 996	87, 043	6, 593, 323

Referring again to the sugar-lands of Louisiana, several of the correspondents of the department are very emphatic in expressing the conviction that the area of land adapted to the production of the sugar-cane in that State is sufficient to furnish the United States enough sugar for its whole consumption, if under proper cultivation. Unfortunately, the lands best adapted to the cultivation of sugar-cane are all more or less subject to overflow. While a very inconsiderable portion of the best lands have been put under cultivation, even a large part of these has been rendered unfit for use by the destruction of the levees. In this connection attention is called to the letter of Mr. Longue, of Saint Charles Parish, as a case in point. He relates that on his plantation, before the crevasse of Bonnet-Carré, his crop was ordinarily from 200,000 to 300,000 pounds, and the crops of seven of his neighbors aggregated about 2,600,000 pounds; but that all these lands, as also those of thousands of others, adapted to the cultivation of sugar-cane, remain uncultivated on account of annual inundations. Another planter states that although he owns three sugar-plantations, he is unable, for the same reason, to work them.

Messrs. A. Thompson & Co., sugar-merchants of New Orleans, describe the sugar-area as follows:

Taking the Mississippi River, from the parish of Pointe Coupée down to within a few miles of its mouth, both its banks are lined the whole length with sugar estates, unequaled for the richness and fertility of the soil, especially the parishes of Ascension, Saint James, Saint John the Baptist, and Saint Charles, and, below the city, the parish of Plaquemines, known before the war as the "Empire Parish," on account of the richness of its productions, and now the great rice and orange growing parish of the State. We have also the lands along the Bayou La Fourche, a rich, black, and exceedingly fertile soil, and showing this year, so far, the largest canes and most promising crops. We must especially report that portion of the country formed of the parishes of Saint Martin and Saint Mary's, along the Bayou Teche, and known as

the Attakapas region. Many Northern and Western capitalists, charmed by the beauty of the country, the salubrity of its climate, and the fertility of its soil, have purchased large plantations, and are yearly turning out paying crops, some of them shipping direct to Northern markets. We have also to mention the sugar-producing regions on Red River, composed of the parishes of Rapides and Avoyelles, where the culture is increasing every year, producing a good sugar and a rich, thick molasses, reddish in color, and unequaled for the grocer's trade.

Mr. F. L. Claiborne, of Pointe Coupée Parish, is of the opinion that there is cane-land enough in the State to make one and a half million hogsheads, if the levees are built up; and Mr. Joseph Anger, of Iberville Parish, a planter of forty years' experience, believes that the producing capacity of the State might be increased 300 per cent. by a proper system of levees.

Lands within the sugar-range are cheap and abundant. It is stated by competent authority that sugar-lands, on the navigable rivers and bayous, may be purchased at from $15 to $20 per acre, while they have a capacity for the production of 2,000 to 4,000 and even 5,000 pounds of sugar, with a proportionate turnout of molasses.

In the appendix will be found a table, collated from the ninth decennial census of the United States, showing the number of acres improved and unimproved in the sugar-parishes of Louisiana in 1869, which shows that in that year there were 748,539 acres of unimproved land, besides woodlands, in the State.

THE CROP IN LOUISIANA.

The sugar-product of Louisiana annually, since 1823, is tabulated as follows:

Years.	Hogsheads.	Years.	Hogsheads.	Years.	Hogsheads.
1823	30,000	1842	140,000	1859	221,840
1824	32,000	1843	100,000	1860	228,753
1825	30,000	1844	200,000	1861	459,410
1826	45,000	1845	186,000	1863	76,801
1827	71,000	1846	140,000	1864	10,387
1828	88,000	1847	240,000	1865	18,070
1829	48,000	1848	220,000	1866	41,000
1832	70,000	1849	247,923	1867	37,647
1833	75,000	1850	211,201	1868	84,256
1834	100,000	1851	236,547	1869	87,090
1835	30,000	1852	321,934	1870	144,881
1836	70,000	1853	449,324	1871	128,461
1837	65,000	1854	346,635	1872	108,520
1838	70,000	1855	231,427	1873	89,498
1839	115,000	1856	73,296	1874	116,867
1840	87,000	1857	279,697	1875	144,146
1841	90,000	1858	362,296	1876	169,331

Yet the methods employed have been of such a character that there may be said to have been a minimum of production, considering what might have been done with good culture and thoroughly scientific manipulation of the cane. While Louisiana gives 1,200 to 1,800 pounds of sugar to the acre (taking the last three seasons as the standard), the West India product is given at 3,000 to 5,000 pounds, and that of the East Indies often runs up to 7,000. It is stated on authority that in the Mauritius the product was at one time increased from 2,500 to 6,000 and 7,000 pounds. But this was by reason of very careful cultivation and the employment of the best means in the extraction of the saccharine matter. Porter, in his work on the sugar-cane (1843), states, concerning Mauritius, that the average production of sugar to the acre, from cane introduced from Java, was 2,000 pounds. In virgin soil of the best

quality more than 5,000 pounds per acre were obtained; but this product was materially lessened the second year, and when the land had been cropped for several years in succession the quantity was frequently reduced to 1,100 or 1,200 pounds.

The matter of lessened yield, or of what is called by planters themselves "deterioration," is one of great moment in considering the question of sugar production. An American authority, writing on this subject before the war, refers to the fact that, "from some cause not well understood, the product of sugar to the acre is not so great as it has been in past years. This may be owing to continued repetition of the same crop without adding manures to the land, or to the practice of reserving inferior canes for seed; while some have supposed it is caused by deterioration of the stock through continued use of cuttings from the same source. To remedy the trouble, in case of this being the cause of deterioration, the United States Government recently [in 1856] collected a new supply of canes from the northern part of South America and distributed them among the planters."*

In his annual Louisiana sugar report for 1876-'77, Boucherau states that cane once planted in Louisiana remains in the ground from three to four years, furnishing from two to three successive crops, and that often the old stubbles are rooted up and the same land replanted in cane. Commenting on this management, he says:

> A contribution so vital exacted from the soil tends greatly to impoverish it; yet this has long been an error in practice, and, what is worse, has been followed by planting in lands so impoverished the short-jointed and hard, woody stubble. It is this that has caused the present deterioration in cane.

He then cites the fact that unsuitable mineral fertilizers are employed, which, while producing an appearance of fertility, in reality impoverish the land, and still further contribute to the deterioration of the cane. When it is remembered that the sugar-crop is one of especial and peculiar exaction, and that under ordinary circumstances even the best soils need rest and replenishment of weakened or exhausted properties, the importance of an intelligent consideration of the best methods of restoring and sustaining our sugar-lands, and of staying the degeneration so generally complained of, will be at once apparent. On this point the observations of Mr. Moore, a planter of Washington Parish, in a letter to the department, are appropriate and suggestive. He says:

> It is a well-known fact that, up to the time of the war, the cultivation of all Southern agricultural products was yet crude and undefined; but should the new appliances of drainage, deep plowing, fertilizing, and improvement in selection, which have enabled our farmers to quadruple yields per acre of their cotton and other products, be extended to the cultivation of the cane, at present prices of sugar, the value of our increased production would be almost fabulous.

So fully impressed is our correspondent, Mr. Von Phul (whose comprehensive letter is printed in full in the appendix), with the loss entailed by loose methods of cultivation, that he strongly recommends the establishment of an experiment station or farm, in order that the sugar-interest may be advanced by proper tests and the solution of a number of perplexing problems in cane-farming. Mr. Von Phul very justly relieves the planter of blame in the matter, giving, undoubtedly, the correct rea-

* In 1843 Congress ordered scientific investigations to be made relative to the chemical nature of saccharine substances and the art of manufacturing sugar, under the direction of Prof. A. D. Bache. The investigations were conducted by Prof. R. S. McCulloh, a chemist of reputation, and were thorough in their character, resulting in incalculable practical good to the planters of that day. A series of three reports, covering the chemical examinations, was published at intervals by the Secretary of the Treasury, the last making its appearance in 1847.

son, the great risk and expense attending pure experimentation. The letter here referred to affords an accurate picture of primitive methods still adhered to for the lack of thorough instruction in better, and, in the end, very much cheaper.

THE BAGASSE.

At the expense of repeating what has already appeared in the published volumes of the department, the following, from the Annual Report of 1873, condensed from a statement by Mr. M. S. Bringier, is incorporated in this inquiry, in order to show the possible profits that have failed to be realized in prosecuting the sugar industry:

The annual average yield of cane on the sugar plantations should be about 60,000 pounds per acre, containing 90 per cent., or 54,000 pounds of juice. The latter, at 80° 5′ Baumé, its average strength, contains 15.3 per cent. of pure dry sugar, making the average total amount of saccharine matter in an acre of cane 8,262 pounds, or one pound of sugar to about 7.26 pounds of cane. The sugar, on evaporation, absorbs water of crystallization, raising the percentage of sugar and molasses to 17.59, in the proportion of three parts of sugar to two of molasses. If there were a perfectly exhaustive process by which the whole saccharine element could be extracted, the average yield of an acre of cane would be about 5,700 pounds of sugar and 3,800 pounds of molasses; but the planters require from 35 to 55 pounds of cane to make a pound of sugar and two-thirds of a pound of molasses. The average of the State is 2.25 pounds of sugar and 1.5 pounds of molasses to each 100 pounds of cane. At this rate of production, an average plantation, with 100 acres under cultivation in cane, yields 135,000 pounds of sugar, at 8 cents per pound, and 90,000 pounds of molasses, at 4 cents per pound; total, $14,400. The expenses of culture are $5,000; of manufacture, $5,400; taxes, overseer, engineer, &c., $2,000; total, $12,400, leaving a net profit of but $2,000. Mr. Bringier thinks it demonstrated that 10.5 pounds of cane will easily yield a pound of sugar and two-thirds of a pound of molasses. At this rate 100 acres of cane, averaging 60,000 pounds per acre, should yield 571,428 pounds of sugar, at 8 cents per pound, and 380.952 pounds of molasses, at 4 cents per pound; total, $60,951.32. The expenses of cultivation and management would be the same as for the actual crop but the cost of manufacture would be enhanced, making the total expense $18,951.32, and leaving a net profit of $42,000, or $40,000 more than is now derived from 100 acres of cane on an average.* These considerations give some idea of the enormous losses inflicted upon the sugar interest and upon the country by unthrifty methods of production. It is a startling thought that probably a hundred million pounds of sugar are annually burned up in the *bagasse* of imperfectly-treated canes.

Mr. Von Phul refers to several processes, more or less successful, for the amelioration of the difficulty here described. But a change for the better appears to be promised, if the statements of Mr. A. De La Cornilliere, in his lately-published work on the "Culture of Sugar-Cane and Sugar Manufacture in Louisiana," be well founded, and the hopes entertained concerning a new method of handling the *bagasse* do not prove illusive. In referring to a recent invention of Mr. M. S. Bringier for the exhaustion of *bagasse*, he says that the apparatus is simple in execution and easily managed, and makes the *bagasse* yield 40 per cent., or 24 pounds, more juice than is furnished by the passage of the cane through the mill alone. "It is a well-known fact," he says, "that the cane, after several pressures, even as many as eight or ten, still yields juice, and that a complete exhaustion can only be obtained by dissolving the saccharine substances inclosed in the cellular tissues." Commenting on the statements of Mr. De La Cornilliere, the following observations are made by Mr. Bouchereau in his last annual sugar report:

The startling fact, so well attested, that 40 per cent. of the sugar-products of Louisiana, through all her great past, secured in the culture, have been lost through the inadequacy of the machinery employed in manufacture; that nearly one-half of the product has been cast away from countless thousands of fields of cane, extending back through so many years, indeed generations, is certainly calculated to arouse the interest not only of sugar-planters, but of society at large in all its classes and conditions, in the question of sugar production for the future, not here only, but everywhere.

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* See also letter of Mr. Bringier to the department, on the same subject, in appendix.

CENTRAL FACTORIES AND SMALL FARMS.

It is evident that if the area of sugar-planting be very widely extended in the adapted regions, including the sugar-belt of Louisiana, Texas, and Florida, there must be a wise innovation upon the old system of large plantations and expensive sugar-houses equipped by individual planters. There is land in great abundance, purchasable at rates very much lower than good farming-lands at the West. It is entirely practicable for these to be worked in small tracts by enterprising farmers, provided the central-factory system, now much talked about at the South, be set on foot. The great expense attending sugar-production, and the especial skill required, reside in the handling of the cane in the sugar-house. If capital erect sugar-factories in the cane districts, the profits of the small producer would accrue from the sale of his raw material. It is simply the carrying by the farmer of his wheat and corn to the miller or the commission merchant. How many small farmers might be expected to flourish at the North and West were it necessary to erect a grist-mill and a distillery on every farm? The system of cultivating small tracts would promote thrift and thorough work, and secure the best attainable results at the South in the cultivation of sugar, as it does at the North in the cultivation of corn and wheat. Such a division of labor would carry an intelligent and skilled element to the sugar-fields and infuse an energy into the industry hitherto unknown. It is satisfactory to note that the intelligent press of Louisiana is awake to this view of the case, and that attention is being particularly directed to the feasibility of the central-factory system and the great advantages to be derived from its practicable operation.

A few planters of Louisiana have already made efforts in the direction of practicing this method, which is found to work well in the French West Indies, and has encouraged many small farmers to raise crops and dispose of them for grinding. Messrs. Walker & Co., to whom allusion has been made before, are decidedly of the opinion that if this system were in vogue a great portion of the uncultivated lands of the State might be farmed out and cultivated in small tracts. They state the single objection that in Louisiana the grinding must be gotten through in the shortest time to avoid frosts, and the country is yet too sparsely populated to furnish enough material for new mills to be worked with success; "however, some of the larger planters are beginning to try the system of buying canes outside of their own crops and grinding them on their mill." But this difficulty, as well as the one of remoteness from fuel, may be overcome. The plan is being discussed of building cheap wooden, horse, or even steam, railways to timber-lands and water-courses from the interior prairie sugar-lands, thence to centrally-located sugar-houses. It is proposed that these roads be built by the united labor and capital of those immediately concerned, affording easy means of transporting both fuel and canes to the mill. "Our prairie-lands," says the Louisiana Sugar Bowl, published in the Attakapas region, "are all destined to be cultivated, principally in cane, as soon as railroads are built to supply the fuel, and we are confident that at least *two* lines from New Orleans to Texas will ere long pass over the prairies of Western Louisiana."

Mr. Walker, of Saint Mary's Parish, refers to the fact of such establishments being carried on where canes are purchased. The average price is $5 per ton of 2,000 pounds, weighed at the factory. In some cases land and seed-cane are furnished by the factory, when $4 per ton is paid for the canes. He states that the average product of an acre of plant-canes well cultivated, on fair land, is eighteen tons.

As will be seen in the appendix, several correspondents reflect a sentiment in regard to the encouragement of enterprising labor from the North, and a desire to change the "old plantation system," that promise the happiest results. Says Mr. Guion, of Assumption Parish, "We need more labor, and we can readily give employment to thousands of white men at remunerative rates, and whom we expect shall become owners of the soil, since large plantations are being rapidly divided, there being no longer here the ambition to possess large quantities of land that are unproductive." Mr. Moore, of Washington Parish, relates that experience at the South since the war has "thoroughly exploded the old theory that sugar could only successfully and profitably be cultivated by slave labor; also, the erroneous impression that good white labor could not be employed in this climate." And in this view he is very intelligently sustained by Mr. Spangenberg, of Jefferson Parish, to whose letter special attention is called. Mr. Austin, of Saint Mary's Parish, says that some effort has been made to introduce a white element there, and he is of the opinion that ultimately, "when the attention of our intelligent, industrious class of farmers is turned to this country, labor will be procured, and that of the right stamp."

SUMMARY.

From the foregoing the following facts are deduced:

1. That the United States is paying annually to other nations immense sums of money for a staple article of consumption which, the proper encouragement and support being afforded, might be produced at home.
2. That the production of sugar in Louisiana, our chief source of domestic supply, was about 63 per cent. less in 1876–'77 than in 1861–'62, while at the same time in the years of largest production a very insignificant part of the whole body of cane-bearing lands have at any time been under cultivation.
3. That the system of sugar-production heretofore followed has not been of a character calculated to produce the best results, great losses having been entailed on account both of the agricultural methods and the mechanical appliances used in extracting the saccharine matter, the loss through unscientific handling of the *bagasse* alone amounting to at least 40 per cent.
4. That an improved system of labor, involving the division and the cultivation of smaller tracts by individual owners, and a more thorough and scientific handling of the cane, would very largely increase the sugar-product and go far toward keeping pace with the annually-increasing demand of the whole country.
5. That successive plantings of the same seed-cane have resulted in a deterioration of the stock that demands serious and immediate attention.
6. That there are immense tracts of unoccupied and abandoned sugar-lands in Louisiana which are purchasable at low rates.
7. That the absorption of these lands by small cultivators depends upon the protection afforded by a good levee system, the establishment of central factories, and the construction of transportation ways.
8. That a very large area, heretofore highly productive, cannot be safely worked on account of inundations arising from the bad condition of levees.
9. That the new system of ownership of small farms, which is now being encouraged, will give growth to individual independence, draw around itself educational and refining influences, and build up and energize new and thriving communities. such as exist wherever self-reliant and intelligent labor flourishes.

The suggestions and recommendations of sugar-cultivators from whom letters have been received by the department are succinctly given as follows:

1. Protection of the lands from overflow by means of a levee system to be devised and maintained by the general government.

2. The clearing up and draining of swamp and low lands, and the determination of outlet drainage, with special reference to encouraging and assisting small planters, the system obtaining in Holland, or a suitable modification of it, being recommended.

3. Labor, white and colored, of which there is scarcity upon the lands even now worked. An element is desired that is willing to work on the tenant system, thrifty, ambitious to own lands.

4. Capital, to improve and clear up lands and "set things to rights," to erect and thoroughly equip sugar-houses, build tramways and lines of communication by means of which lands remote from water-courses may be carved into farms, and to introduce the most approved agricultural and manufacturing appliances.

5. Improvement of cane-seed through importations from other latitudes, to be distributed among the planters of the State.

6. In view of the great importance of securing a maximum amount of juice from the cane and the most desirable methods of manipulating it after expression, in order to produce a superior article of commerce, the appointment of practical chemists to study the operations of manufacture on the ground. These also to analyze the soils, provide means for converting the "trash cane" into a fertilizer, and to suggest such other fertilizing means as may best conduce to the re-establishment of weakened or exhausted soils.

7. The establishment of an agricultural college on the general plan of those at the North.

8. The establishment, by State aid or otherwise, of an agricultural station or experimental farm, for determining questions bearing upon the sugar-industry, since experimental tests conducted by individuals lack thoroughness, on account of the expense and time required to carry them forward to complete and reliable results.

APPENDIX.

EPITOME OF LETTERS FROM SUGAR-PLANTERS OF LOUISIANA.

JOHN D. MURRELL, Iberville Parish:

The national government should take our levees in hand and protect us from the disastrous annual overflows. It should also give us protection by placing a uniform tax of 2½ or 3 cents per pound upon *all* grades of unclarified sugars, and from 4 to 4½ cents upon clarified sugars imported. Immigration should be encouraged. Laborers are our great necessity; and with plenty of them, and the proper protection, the sugar-crop of this State would soon swell into hundreds of thousands of hogsheads annually.

CHARLES H. WALKER, of Walker & Thompson, Franklin, Saint Mary's Parish:

The lands best adapted to the cultivation of sugar-cane are all more or less subject to the annual overflow of the Mississippi, and their protection by the national government is imperatively necessary. * * * We want to improve our seed-cane; the loss by spoiling is annually on the increase, showing that it is deteriorating. We need fresh importations from other countries, to be distributed in small parcels to the planters. * * * We need more laborers. In the Teche country we pay from $15 to $25 per month for men, and provide them house, garden, fire-wood, rations, half an

acre of land in field, and team and half of Saturday to work the same. We pay from 50 to 75 cents per day for women, without rations. During sugar-making we pay $1 per day and 50 cents for one-half the night. There are more wanted than are in the country. If the department could spread this information among the freedmen in other localities where there is a surplus and where they cannot get remunerative wages, or if they could be assisted in emigrating from such places, it would benefit the freedmen and the country. * * * Central sugar-factories are being established, where canes are purchased. The average price is $5 per ton of 2,000 pounds, weighed at the factory. In some cases land and seed-cane are furnished by the factory, and $4 per ton paid for canes. The average product of an acre of plant-canes, well cultivated, on fair land, is eighteen tons. * * * We need a more thorough knowledge of the chemical constituents of our various soils and the requisite fertilizers to increase the product of sugar.

HENRY WARE, Iberville Parish:

The soil in this section of the country, for richness and durability, is not excelled by any lands in the world, a large quantity of which is now uncultivated, and a large part of that so badly as to produce but little over half crops. * * * We need more capital and labor. If the large capitalists of the North and West could understand fully the large income to be realized from proper cultivation of these lands in sugar-cane, they would supply the needed capital. Labor would follow in abundance from different parts of the South, where both colored and white laborers are eking out a poor living on run-down lands in cotton and corn. * * * We need a good levee system in the hands of the general government.

E. W. MOORE, Washington Parish:

Only a small proportion of the best sugar-lands of Louisiana have been put under cultivation, and a considerable part of these have since been rendered unfit for use by the destruction of our levees during the war, we being unable to restore or keep them up. Could the Federal Government be induced to extend to us, in our present ruined condition, any assistance, not only in rebuilding our levees, but also in establishing a proper and thorough levee system, these abandoned acres would again be restored to the production of sugar, and there would be redemption of a body of alluvial land equal in extent to one-third the area of the whole State, superior in fertility to any other equal body of land in the Union, unexcelled by any in the world. * * * It is a well-known fact that up to the time of the war the cultivation of all Southern agricultural products was yet crude and undefined; but should the new appliances of drainage, deep plowing, fertilizing, and improvement in selection, which have enabled our farmers to quadruple yields per acre of their cotton and other products, be extended to the cultivation of the cane, at present prices of sugar the value of our increased production would be almost fabulous. * * * The cost of the levee improvements would be trifling, compared to the immense benefits to be derived not only by ourselves but by the whole country indirectly, to say nothing of the moral influence in healing past dissensions. * * *

The labor question.—Our experience since the war has thoroughly exploded the old theory that sugar could be successfully and profitably cultivated by slave labor only; also the erroneous impression that good white labor could not be employed in this warm climate. Under this theory, it would be difficult to explain the prosperity of highly productive countries in some parts of the world inhabited almost if not exclusively by the white race, situated much nearer the equator, and, consequently, in much warmer latitudes. My own experience, extending back to my earliest recollection, is that we have always had good white labor. The western and southwestern sections of this State have always been, with few exceptions, almost exclusively inhabited by the white race, among whom are many choice white laborers. * * * Owing to the heavy labor required in the cultivation and manufacture of sugar, as a matter of economy our experience has taught us the expediency of substituting machinery for manual labor wherever practicable. An advance in this direction before the war had made considerable progress. In this respect we not only led but placed ourselves far ahead of all sugar-producing countries, simplifying and cheapening all processes.

C. B. AUSTIN, Saint Mary's Parish:

The main question is how to obtain sufficient labor. In this respect we are deficient, and there is much diversity of opinion on the subject. Some advocate the introduction of Chinese; many send agents to the Carolinas, Georgia, and Virginia; but those negro laborers are generally inferior to our own as to work on a sugar-plantation. I only employ the Louisiana colored man. Some effort has been made to introduce a white element from the North and West, and I believe that ultimately, when the attention of our intelligent, industrious class of farmers is turned to this country, labor will be procured, and that of the right stamp.

JOHN B. PITTMAN, La Fourche Parish:

Encouragement of labor and capital is most needed to increase the production of sugar in Louisiana. There is abundance of land now lying idle, run to weeds. At present prices, sugar is the most profitable crop that can be raised. Many sugar-plantations for several years have been cultivated in rice, but the prices of rice are not sufficiently remunerative now. Reliable labor is scarce, even for the amount of cane now raised in the State.

L. G. ALDRICH, Assumption Parish:

I would suggest as follows: 1st. An importation of choice varieties of seed-cane to be placed in the hands of responsible parties who may take sufficient interest in the subject to devote their attention to acclimatizing them and obtaining the best results. 2d. A thorough and exhaustive analysis of the various fertilizers now being extensively used on cane, with a view to ascertaining which contain in most perfect form the elements essential in production of the component parts of cane and least destructive of the natural vitality of the soil, in order that we may be able to avoid the dangers which, to a certain extent, manifested themselves to the beet-growers of Europe, who, in order to obtain large results, fertilized to such an extent and with such material as to kill the land. In times past the fertilizer almost exclusively used was the pea-vine, which produced the result desired, partly by decomposition of the vine and in part by the dense shade it produced; but now there is yearly a largely increasing use of cotton-seed meal and other fertilizers, which, while they produce immediate grand results, will, in the opinion of many planters, work disaster to our land in the end.

NORBERT LANGUE, Saint Charles Parish:

In order to extend the production of sugar, according to the desire of the department, it will be necessary to put in a condition of culture the lands that have been abandoned since the great crevasses which inundated a considerable portion of the soil of Louisiana. These lands, formerly covered by abundant crops of the sugar-cane, now present to the view a vast and melancholy expanse of ruins and swamps, in which the waters of the Mississippi seem permanently to rest. I will cite but one example of the ruin of these lands, that of the destruction of my own and of some of my immediate neighbors. On my place, before the crevasse of Bonnet Carré, my crop ordinarily was from 200,000 to 300,000 pounds. The crops of seven of my neighbors were in the aggregate about 2,600,000 pounds. All these lands, as also those of thousands of others, adapted to the culture of the sugar-cane, remain uncultivated, for the reason that every year they are inundated by the waters of the river. The State has not the means of reconstructing the levees and closing the openings through which the waters come to drown the lands.

LEWIS GUION, Assumption Parish:

There is yet lacking confidence in the stability of our levees, which has discouraged immigration and sugar-production, and has caused a large area of the richest portion of the alluvial land of Louisiana to grow up in weeds. Should the government build up the levees of our inland sea, which washes the shores of so many States, and which has begun to be considered a national work, there will be an immense revival of the sugar-interest. * * * We need more labor, and we can readily give employment to thousands of white men at remunerative rates, and whom we expect shall become owners of the soil, since large plantations are being rapidly divided, there being no longer here the ambition to possess large quantities of land that are unproductive. * * * The department can do a great deal of good by sending a practical chemist to Louisiana about the 1st of October, to spend a winter in observing the modes of making sugar, the fertilizers employed and their effects, in analyzing the various soils, and especially suggesting some cheap and practicable mode of quickly converting the large mass of *bagasse* into a fertilizer, either by machinery, cutting it up into small particles after passing through the rollers, or by composting with some substance which would quickly decompose it at small expense. I believe it is entirely practicable to begin the use of tile-draining. If the department would try the experiment on a small scale on some sugar-plantation, I am satisfied the yield of sugar would be largely increased.

DANIEL THOMPSON, Bayou Teche:

Our seed-cane is undoubtedly very much deteriorated, as very little, if any, has been imported since 1861. If Congress can be induced to aid in the importation of some fresh seed, it will be of very great benefit to our planters. * * * It may not be out of place here to state some of the influences which, I think, militate against a large production of sugar in Louisiana. It is a fact that the lowest lands that can be cultivated in cane in Louisiana are much the most productive. There are immense tracts of

these productive lands, that were in cultivation before the war, that are now lying idle, in consequence of the inability of the State to rebuild and keep in repair the levees on the banks of the Mississippi River. Even if this could be done in Louisiana, it would not avail much till the levees on the Mississippi are rebuilt in the States of Arkansas and Mississippi. Another of our misfortunes is that larger quantities of foreign sugar finds its way into our market without paying full, if any, duties. * * * In addition to fresh seed, I think the next greatest good to planters might be realized by the establishment in Louisiana of a State agricultural college, and the employment of a practical sugar-chemist to analyze our soils and the fertilizers we use, and to aid us with information regarding the manufacture of our sugar.

R. F. SPANGENBERG, Jefferson Parish:

The first thing necessary to be done to increase the production of sugar is to secure all the cultivable lands from overflow. The levees should be taken care of by the government. This one important step alone would insure immigration and capital. * * * It would be well to employ Northern white labor on the levees, on the railroads (say Southern Pacific), and the canaling, formerly done by Irish and German; also on the steamboats that ply on the Mississippi. This would give the sugar-planter the benefit of the labor of the negro on the plantations, where he is so well fitted for the duties of gang-labor. In harvest-time, when extra labor is required, the Northern white might be employed; and, little by little, he would learn something of sugar-planting, and finally be able to live on a plantation and make a crop on the share or tenant system—the only way in which to employ whites in sugar-culture, supposing them to be intelligent and thrifty, and ambitious themselves to be land-owners. This is the proper way in which to start new places and put new sugar-lands under cultivation. What is said concerning the whites not "standing the climate" is "all bosh." All the gardening for the New Orleans market is done around me on small places by white men, who work intelligently and take their *siesta* between 11 a. m. and 3 p. m., thus avoiding work in the heat of the day; in fact, I do the same *to save my mules*, to say nothing of the advantage to my negro laborers. Again, all heavy work is done by July, as then the sugar-crop is *laid by*. Having traveled seven years in Europe, I saw what white labor did there in the southern parts. This place includes 4,000 acres of land; 1,000 are in pasture, corn, and cane; say 340 in cane. Aiming at 1,000,000 pounds of sugar next year, I shall roll only 200 acres, reserving the 140 to make a large planting. With a fair season these 200 acres should give me at least 400,000 pounds of refined sugar (white and yellow clarified), worth, at present prices, including molasses, between $45,000 and $50,000; cost of making and staking off, $25,000 (including any permanent improvement); showing a profit of 80 to 100 per cent. on the outlay to make the crop. I have the most improved machinery invented, put up last year; sugar-house and machinery worth $50,000.

E. D. BARTON, Napoleonville, La.:

The most essential things for the promotion of sugar-culture in the State are, 1st, a good levee system; 2d, good drainage; 3d, increase of labor.

JOHN H. RANDOLPH, Iberville Parish:

Louisiana might make enough sugar for the whole United States if all our swamp-lands were cleared up and drained and substantial levees built on the Mississippi river.

F. S. BARBOUR, Plaquemines Parish:

Induce the government to take charge of the levees, and send us some of the surplus labor of the North to rebuild them and make them safe, then capital would come and labor would follow.

VINCENT BOGUE, Saint Landry Parish:

We want industrious white men, but men who will come to us with a sense of duty.

MARTIN GLYNN, West Baton Rouge Parish:

The only material aid the government can give toward increasing the production of sugar in Louisiana is to build levees. I expect to make 300 hogsheads of sugar this year. In three years I could increase the amount to 1,200 were I secure from overflow. * * * Some think a change of seed would be an advantage; but with security from overflow we can make large crops with the cane we have at present.

A. J. J. BARRIS, Terre Bonne Parish:

I am the proprietor of three plantations in this State, and am unable to cultivate any of the three on account of overflows; nor am I the only one so situated. There are thus thousands of pounds of sugar annually lost to our markets, thereby increasing our sugar importations and losing to the country millions of dollars. In my opinion the

efficacious mode of avoiding this loss is for Congress to make some special appropriations for the building and protection of our levees, the government retaining control of them. This, I firmly believe, is the best and only way by which our sugar-interest can be promoted and our importations diminished.

F. L. CLAIBORNE, Point Coupee Parish:

The sugar-lands of Louisiana can be made to produce all the sugar that is required for consumption in the United States, and to spare. It is true the sugar-cane belongs to the tropics—it is an exotic here—but American skill, industry, and inventive ingenuity, and improved and improving modes of cultivation, will enable the Louisiana planter to make as much sugar as can be extracted from cane anywhere else. * * * A commission of three practical and intelligent planters should be sent to where the cane is indigenous to import selected seed for equal distribution among all the sugar-planters of the State. * * * There is cane-land enough in Louisiana to make one and a half million hogsheads of sugar, if the levees on the Mississippi are built up. Good and sufficient levees, capable of securing the Louisiana sugar-belt from overflow, can only be made through government aid. Let Congress aid us, and we will reclaim sugar-land enough to supply the United States and to export largely; thereby the cotton and sugar interests would be developed to so great an extent, that in three years the government, through increased imports, would be reimbursed three times over, and the internal trade and traffic between the States would be enormously increased.

W. H. BALLARD, Ascension Parish:

The government could render us great assistance if it would send to the State several practical chemists during sugar-making to watch the process and to devise means for destroying the coloring matter and for removing the vegetable impurities existing in the cane-juice. In order to give our sugar and sirup a good appearance, we use the fumes of sulphur to destroy the coloring matter, which, when combined with lime, that is used for removing other impurities in the juice, renders the sugar highly deliquescent, causing it to run off in the shape of molasses. This entails considerable loss. It is also desirable to devise means by which to check fermentation in the molasses. It is rarely the case that planters pretend to know anything about the handling of the juice in order to make good sugar. Through proper instructions furnished, the government could accomplish a great good, saving us from an immense loss in handling the juice, and increasing the production of sugar correspondingly. Besides this, and the importation of new varieties of cane, I do not know that the government could particularly serve us.

JOSEPH ANGER, Iberville Parish:

Sugar-culture in *ante-bellum* times was by far the most profitable crop the farmer could cultivate, and since the war it has proven even more so. I have been a practical sugar-planter for forty years on the Mississippi, and through many vicissitudes, without much loss. I find our methods of production and manipulation susceptible of great changes. As to the best method of promoting this great and growing interest, the first step must be taken by the government in the reclamation of the low lands, upon which, principally, sugar-cane is grown. The country especially adapted to sugar-culture is that portion of the alluvial region bordering on the Mississippi below Vicksburg. The present producing capacity of our State, by a proper system of national levees, can be increased 300 per cent. * * * Fifty years' experience in this State has demonstrated the utter futility of the State attempting to keep up its own levees. Legislation of a national character is necessary to a reclamation of the low lands. Suppose all the riparian and interior communities of this State were protected from the Mississippi south of the Arkansas line, the levees above being in bad condition; if a break occur, the water will come south through the Yazoo Valley on the one side and break through the Bayou Macon Hills from the Saint Francis Valley on the other, flanking the whole interior, and rendering a supposed good system south wholly a nullity. * * * With the fostering care of the government extended to our levees, local capital and increasing good labor will soon place our section in the foremost rank of sugar production. * * * Government might assist us in the way of importing tropical seed, as some of our cane has very much degenerated. * * * My lands readily yield me a net income of $60 per acre.

JOHN DYMOND, New Orleans:

I would suggest one thing that I think of grave importance, and that is the determination of some method of outlet-drainage by a combination of small proprietors. Thus far large estates have been the rule in Louisiana, and the outlet-drainage has been obtained by digging large canals long distances to lower levels, or by digging canals and elevating the water from the same and throwing it over and beyond the rear protection levees by means of large drainage-wheels, such as are used in Holland. I have just erected one of these wheels, which will throw out about 50,000 gallons of water

per minute, and the wheel, engine, boilers, foundations, &c., and about ¾ mile of canal, 20 feet wide and 5 feet deep, have cost me $15,000 cash. It is this drainage matter that interferes with small proprietorships in Louisiana. In Holland they organize local drainage districts, calling them *Polders*; and they are duly surveyed, inclosed by levees, or dikes, as they are called, and duly drained by steam or wind wheels. This I understand to be done by commissioners elected by the proprietors, and managed perhaps as a bank or incorporated company, under the so-called *Polder* laws, the cost being assessed on all the land inclosed within the *Polder*. I own many thousand acres of land in Louisiana, and all that is under cultivation is drained five feet below the level of the land artificially, at an expense of less than $3 per acre per annum. Not one-quarter of this land would produce good crops without artificial drainage. Should I sell forty acres, the purchaser would at once have his drainage closed, or be compelled to make some *temporary* arrangement with me, and hence but a few such sales have been made; and I do not see how they can be in the best alluvial lands, which are all low, until this problem is solved. They have been solving it in Holland for five hundred years, and, I presume, have a full code of laws in relation to the matter. I think you can hardly do any greater service to the sugar industry, and particularly to the freedmen and small proprietors, than by obtaining these laws and translating them into English, and circulating the same in Louisiana.

CHARLES STARR, Saint Martin's Parish:

Louisiana should produce sugar enough for the whole nation; but one great drawback is the want of capital, as the most of the planters were ruined by the war, and the reported violence, &c., of the people have deterred Northern men from coming in. So far as I can judge (and I have had exceptionally good means for information), no Northern man who minds his business has had any difficulty. I am well known as a pronounced Republican, and openly voted for Hayes and Wheeler; and no one has given me the cold shoulder. It seems to me unfortunate that the treaty with the Sandwich Islands admits sugar free, for two reasons: First. I had been informed that the farmers of California were going largely into beets for sugar, it having been ascertained that the climate and soil of that State were exceptionally favorable for sugar-beets. As a result of the treaty that enterprise, I am informed, has been abandoned. Second. Although the area of land for sugar-cane in those islands is not very large, the area for fraud seems to be unlimited. No doubt attempts will be made on an immense scale to land cargoes of East India sugar there, refine it, and ship to the United States and elsewhere. It is true that the consuls and others may have instructions from the government to look closely after the matter, but the inducements for fraud will be enormous, and it will take a good deal of virtue to withstand them. In answer to the inquiry, "Why cannot sugar be raised in small quantities by the negroes and others, and small or portable mills and evaporators be used for manufacturing the same?" I reply that the best mills, with steam-power, do not get more than two-thirds of the saccharine matter from the cane, and the horse-mills very much less, and consequently they are very wasteful. Various plans have been adopted to supplement the mills run by steam, and some of them, apparently, have made considerable gain; and as a good deal of invention is enlisted in the enterprise, we may fairly look for considerable gain in the product of the cane. The true interest of the small farmers is a union for a good apparatus; or, where they are within reach of a steam-mill, &c., either to sell their cane or have it made up on shares. Around my plantation are many small planters, black and white, and they have had their crops made up at my sugar-house, and are increasing the production of cane and diminishing that of cotton. This is the true policy, and will largely add to the production of sugar.

Messrs. A. THOMPSON & Co., New Orleans:

We have tried to gather and place in the hands of the department all information in our power, in view to aid in furthering the interests of the production of sugar. The area of land adapted to the production of the sugar-cane is adequate to furnish the United States with enough sugar for their consumption if under proper cultivation. Taking the Mississippi river, from the parish of Pointe Coupée down to within a few miles from its mouth, both of its banks are lined the whole length with sugar-estates unequaled for the richness and fertility of the soil, especially the parishes of Ascension, Saint James, Saint John the Baptist, and Saint Charles, and below the city the parish of Plaquemines, known before the war as the Empire Parish for the richness of its productions, and now the great rice and orange growing parish of the State. We have also the lands along the Bayou La Fourche, a rich, black, and exceedingly fertile soil, and showing this year, so far, the largest canes and most promising crops. We must especially report that portion of the country formed of the parishes of Saint Martin and Saint Mary, along the Bayou Teche, and known as the Attakapas region. Many Northern and Western capitalists, charmed by the beauty of the country and the salubrity of its climate and fertility of its soil, have purchased large plantations, and are yearly turning out paying crops, some of them shipping direct to Northern markets. Among these planters a few have introduced the system used in the French

West India Islands of central sugar-mills, and are buying the cane grown in the neighborhood, thus enabling the small planter to raise a crop and sell it without expense of machinery for grinding, &c. If this system were more in vogue we have no doubt that a great portion of our uncultivated lands would be farmed out and cultivated by small planters, and add thereby greatly to the general prosperity.

There is one drawback, however. In the tropical countries the grinding is not interfered with by cold weather, while in Louisiana it has to be got through in the shortest time to avoid frosts, &c., and the country is yet too sparsely populated to furnish enough of material for these mills to be worked with success; but, however, some of the large planters are beginning to try this system of buying canes outside of their own crops and grinding them in their mill. We have also to mention the sugar-producing regions of Red River, composed of the parishes of Rapides and Avoyelles, where the culture is increasing every year, producing a good sugar and a rich, thick molasses, reddish in color, and unequaled for grocers' trade. We would recommend that your department publish in some pamphlet form statistics showing the advantages of sugar-producing districts in this State, and thereby insure immigration to a magnificent, fertile, and most healthy part of the United States. The yellow fever, which is sometimes brought to this city by vessels from Cuban or South American ports, seldom extends into the country; and New Orleans is this year, according to statistics, the healthiest city in the Union. We would also suggest that the department afford to sugar-planters all facilities of knowledge of improvements here and in foreign countries on boiling and making sugar, and especially experiments in manuring and fertilizing the land, &c., and that the government establish a chemical laboratory to analyze the different soils, and give information as to the proper fertilizers required to increase the growth of the cane. It could be established in the custom-house or other central government building in this city. This we consider one of our greatest needs. The government should, through its agents abroad, procure seeds of the different kinds of canes, and distribute the same among the planters, or sell it at a nominal price. Experiments could then be made to test the best kind adapted to the soil and climate. We have ourselves made experiments on the Bourbon and Java or ribbon-cane, and find that the latter has nearly doubled the yield per acre; *i. e.*, where we made 1,200 to 1,500 pounds of sugar to the acre before using the ribbon-cane, we have doubled the quantity since using it, and furnish our own experience, which we trust may be useful for the planters at large. The Otaheite cane was largely cultivated before the war, but has since degenerated. It is very sensitive to frost, and has been replaced by the Java and Bourbon on that account. Your attention is especially called to the above, as the want of good seed-canes is one of the most pressing of our planters, and we think that the government, with its numerous agents, is naturally the one whom they should look to in this matter. Many planters, as their means increase, are leaving the old system of open kettle and adopting the vacuum pans and centrifugals, thereby increasing the quantity and improving the quality of their products, and by the employment of an adequate number of mechanics to attend to this more intricate machinery, are adding to the general prosperity. The fears of crevasses or overflows have from year to year caused serious apprehensions among the planters on the Lower Mississippi. The Bonnet Carré crevasse (not yet closed) has ruined many a planter and brought desolation on several hitherto fertile and rich estates. In view of this, we strongly recommend that the general government take entire charge of the levees and place them under the control of officers of the United States Engineer Corps. We think the present system of determining the classification of sugars imported from foreign ports detrimental to Louisiana sugars, inducive to fraud, and not proper to fully ascertain the exact grade of the sugar, and would seriously recommend that the test be made by polarization as well as color, else we do not see how it is possible to arrive at anything like a correct or definite classification. One of our present utmost needs is labor, which is scarce and wanted. There are sugar-lands along the Gulf coast which are now lying in waste and unproductiveness, not only in our own State but also in Alabama, Florida, and Texas, and if labor could be had and the surplus population of Northern cities be made to understand the cultivation of these lands it would add greatly to the prosperity of the country at large. The colored laborers are working well, being promptly paid, and as a general rule all intercourse between the planters and their hands is as desirable as can be. We are ourselves owners of a large plantation below the city, employing quite a large number of hands, and find them happy and contented, never giving us the least trouble, and working well. In conclusion, we will say that we are pleased to see the government trying to promote and encourage what will be one of the largest agricultural products of the country, and we shall take pleasure in furnishing the department with all the information in our power concerning the coming crop, which so far promises well and will probably exceed the late one by about 5,000 to 10,000 hogsheads, with an average yield of molasses.

D. W. BRICKELL, New Orleans:

For half of October and all of November and December we want a large number of good workingmen to help take off our crop of cane. We want them for both indoor

and outdoor work; and, to extend our operations, we shall want them afterward. * * * Beyond question, white immigration is necessary to the development of the country, as the development must take place on the system of small farming and central sugar-houses, the growth and the manufacture of sugar being separate industries. But immigrants who come here and go to work for wages with the large planters for one, two, or three years will be best off; as, while becoming used to the climate, they are learning all about cane cultivation and are laying up something to make a beginning themselves. * * * Although making sugar on a large scale is fairly profitable to the large planters, it is infinitely more so to the small ones, especially those who take their cane to another man's mill and keep their capital in the culture. The Western farmer knows no business so profitable. We of the South always knew that the white man could work here as well as the negro.

JOHN C. COFIELD, Ascension Parish:

An obstacle in the way of the production of sugar in this country is the expense of the machinery required in the re-establishment of the old plantations devastated by the war, and few persons are willing to incur such heavy expense without some assurance that the laws will be permanent and their investments secured against changes in the policy of the government. Many plantations, also, now cultivated in cotton, might be transformed into sugar-cane, and in a very few years enough sugar could be produced to supply the entire consumption of the United States. * * * Sugar-planting does not admit, unless in very favorable situations, of the raising or growing of our own supplies of provisions, and our food, machinery, &c., must be supplied chiefly by the Western and Northern States. On that account there is a reciprocity of home interests to be obtained by the enactment of permanent revenue-laws to encourage the production of sugar. The greater the number of plantations brought under culture, the greater demand will there be for provisions and machinery from the West and North.

SAMUEL CRAGIN, Terre Bonne Parish:

Anything the department can do to introduce a cheap and good fertilizer suitable to our soil and crop would greatly stimulate the sugar-industry.

J. M. HOWELL, La Fourche Parish:

Nine-tenths of the sugar-lands are subject to overflow; and as the growing of a sugar-crop requires the expenditure of a large amount of money, people are loath to engage in such enterprises on a large scale with the little protection they now have against the disasters of an overflow.

H. VON PHUL, East Baton Rouge:

The first matter for consideration, for it is vital in importance, is the immediate adoption of a new and important levee system—one that will be complete and satisfactory in all its details. You are doubtless aware that under the old *régime* the riparian proprietors were obliged to build and keep in repair their levees. Since the war, owing to our impoverished condition and the ravages entailed by the war, this system was found impracticable. The State resorted to a general levee-tax; but this system, owing to a bankrupt treasury, depreciated State bonds, and, I fear, dishonest State officials, has resulted most unfortunately, and was found to be futile. Our last legislature again threw the responsibility of maintaining our levees upon the riparian parishes; but this, for reasons given above, will be found impracticable.

The opinion is now general that, owing to the impoverished condition of the South, it will be impossible for her to build and maintain her levees without the aid of the general government; and as this important subject has been, and will again soon be, before Congress for consideration, I respectfully refer you to our petition for full particulars on this important subject, which I think cannot be regarded otherwise than as national. We therefore hope that the general government will either build and maintain the levees along the great highway or lend aid in so doing. This done, and minor subjects receiving due attention, the prosperity of the South and the sugar-interests of Louisiana would rest upon a solid foundation. Then, and then only, would be realized the most sanguine expectations. In short, with our climate, soil, and great natural advantages, there would be no estimating her capacity or the limit to her resources.

Second in importance to our levees I regard the immediate establishment, by State aid or otherwise, of an agricultural station or experimental farm. We live in an age of wonderful progress and general improvement, and it is important that agriculture should keep pace with this onward march. Individual experience is too slow for the times; particularly is this the case for a satisfactory and successful progress of the sugar-interest; but with the aid of an experimental farm important facts could soon be established, the benefits of which to the planters and States could never be fully estimated. Up to the present time few intelligent experiments have been made in the general cultivation of the sugar-cane. This is not, in my opinion, owing to a want of

the proper disposition or want of intelligence on the part of the planters, but owing chiefly to the great expense and risk that such experiments entail.

With the aid of well-conducted experimental farms, the following information could in a few years, be given, the beneficial results of which would be incalculable:

1st. What is the best time, and what the best method, to plant cane?

2d. What is the best time, and what the best method, to secure seed-cane?

3d. What is the best method of securing rattoon and stubble cane?

4th. What is the best method of cultivating plant-cane?

5th. What is the best method of cultivating rattoon and stubble cane?

6th. What is the best method of cutting cane for the mill, with the view to the future preservation of the plant or stubble?

7th. Is not the practice, now in general use, of hilling cane detrimental, cutting cane-roots injurious, &c.?

8th. Is not flat cultivation of the cane in accordance with its natural growth, and hilling, as now practiced, injurious?

9th. What is the best method of rotating for cane-crops?

10th. Which is preferable, machine or hand-hoe for digging off stubble-cane?

11th. Which is preferable, machine, horse-hoe, or hand-hoe, for "laying by" plant-cane?

12th. What is the best fertilizer for cane?

13th. What is the best method of feeding a cane-carrier so as to obtain from the mill the best results?

14th. What process for extracting the cane-juice by the aid of the mills now in use is preferable?

15th. Can cane-juice be improved by settling in tanks or otherwise? If so, what is the best method, and how long should it stand?

16th. What is the market-value of sirups (density and polarization being given) as compared with sugars?

In my remarks regarding the cultivation of the cane and how best to extend the same, I shall not enter into details of the operation, which is familiar to most persons interested, but shall simply make mention of what I regard the errors of the present system, and will preface my remarks by observing that the genius of American agriculture is too superficial. We want better farming, less area of land; in short, we must cultivate better and do more of it than formerly. How this is to be accomplished is the question that must be solved satisfactorily before we can hope for a decided improvement or extension. All lands intended to receive plant-cane must be thoroughly broken by at least four mules, with the best improved plow, and in the fall, if possible. Deep plowing is indispensable, for upon it depends the successful use of the present highly-improved agricultural implements, now happily within reach of all that desire them, and by the aid of which we can readily pulverize the soil and keep it in the desired condition.

I am fully assured of the fact that no class of men are so "wedded to their idols" as the farmer and planter. "My father was a successful planter; he cultivated his fields thus and thus, using such a plow and hoe (that everlasting hoe); he made good crops. It is true that lands were fresher than now, but I respect his memory, and shall ever do as he did." This, I believe, is the argument of all the good old planters and farmers of the country. But, with all due respect to them and their inherited opinions, we must acknowledge that times have changed, and we might as well ignore the steam-car and return to the old stage-coach as adhere to that everlasting hoe and plow. It is a popular error to adhere to and rely exclusively upon the plow and hoe. The same results can be accomplished by the use of the present improved agricultural implements, and at much less cost.

To illustrate: one man, under favorable circumstances, will dig off the soil from, say, one acre of stubble-cane in one day. Now, with the aid of an improved stubble-digger (such as I have used for the past three years) one boy, seated on the machine, and two mules will accomplish the same amount of work in one hour; and, in my opinion, the machine-work is infinitely preferable. Again, one man can lay by (that is, give the cane the last working), say, one acre of cane; with the aid of an improved horse rotary-hoe this amount can be accomplished in thirty minutes, by the aid of two mules and one man, the operator riding and having a good easy time of it. I might continue my illustrations, but let the above suffice. What I wish to impress upon the planters of the South is this: too much reliance is placed upon the hand-hoe, and our fields in consequence are badly, if not too expensively, cultivated. Hand-hoeing is doubtless necessary for a foul drill, but only then; with middles kept in perfect order, that is deeply and thoroughly pulverized by the aid of an improved cultivator, all the necessary work can be accomplished by the aid of improved implements, thereby lessening the expense of cultivation.

In order to reduce our expenses of cultivation we must lessen the hand-hoe work This can be to a very great extent accomplished by increasing our team; for each plowman we should have at least three mules. A full team and the use of improved implements will enable the planter to pass over his crops once every week. With

regard to the manufacturing of sugar from the cane-juice, too much praise cannot be given to the sugar-planters of Louisiana. They have, indeed, exhibited a high order of intelligence—spared no expense to perfect their machinery; and to-day Louisiana, with just pride, can point to her marvelous achievements. Her sugar will compare favorably with, if it is not superior to, any other made. But while the manufacturing of the cane-juice into sugar has been perfect, I cannot help thinking that our planters have sadly neglected other points connected with this branch of the business. I regret to say that there is yet a great want of diligence and proper exercise of judgment in the general management and use of the cane-mill. For the past two seasons I have had occasion to visit some of the largest and best-appointed sugar-houses in the State. These establishments were manufacturing beautiful sugar, the apparatus for manufacturing being faultless; yet I cannot but express the opinion that not one of those I visited was returning fair or satisfactory results. I found, as a general rule, mills running at too great speed, great negligence in feeding cane-carriers, the *bagasse* absorbing in its exit from the mill large quantities of juice. Few mills in the State are realizing for their owners over 60 to 65 per cent. of cane-juice. This loss can in a great measure be reduced by proper attention to the adjustment of the mill and great care in feeding the cane-carrier, so as to deliver the cane to the mill in a continuous and uniform quantity. Having given this subject close attention, I have found the best results by adjusting the mill to receive the canes from the carrier only one cane deep, but uniformly spread over the entire surface of the carrier. In this way the supply of canes enters the mill regularly, and if the supply is continuous the pressure exerted by the mill is uniformly exerted to its utmost capacity. Should the planter find that by such a feed he cannot keep a supply of juice sufficient for his daily necessities, he will find it greatly to his interest to dispose of his mill for one of greater capacity. It is a well-known fact that no mill has yet been devised that will extract all the cane-juice known to be contained in the cane, the best practicable results, as remarked above, being from 60 to 65 per cent.; but I believe that a large majority of the planters do not realize over 50 per cent. To meet this difficulty, we here present to the consideration of those interested several new processes:

1st. The Robert diffusion process, which, I regret to say, proved unsuccessful.

2d. The Mason process, which I believe possesses many advantages. In this process the inventor deals with the *bagasse* after it has left the first mill, and then saturates the *bagasse*, after which it is carried to a second mill and again subjected to a great pressure. By this process the inventor claims an increase of 15 to 20 per cent. of juice over the old process.

3d. The Mallon process. This process has been in operation for the past three years on Hollywood, and for simplicity and insignificant cost recommends itself to all interested in the sugar interest. The apparatus consists in placing a perforated steam-pipe in the cane-knife or return-plate, and applying steam direct from the boilers to the cane while passing through the mill. The inventor claims an increase of 20 per cent. over the old process; and the practical experiments at Hollywood demonstrate that 72 per cent. has been obtained from old stubble-cane and 74 per cent. from plant-cane. The cost of making this application to the mills as now used is about seventy-five dollars.

I believe that the cane-planting interest is fully alive to the importance of improving the lands by judicious fertilizing; yet the question of the best fertilizers for cane is not easily determined. Guano, stable-manure, cotton-seed, and cotton-seed meal, and other spent manures, will make all plants grow with luxuriance; but which is the best fertilizer for the formation of rich saccharine in the sugar-cane is a question yet open for further experiment. From all I can learn upon this subject, I am of the opinion that the formula of Mr. George Villé is the best; the component parts of which are phosphate of lime, nitrate of potash, and sulphate of lime in due proportions.

There is yet another subject well worthy of due consideration of both planters and capitalists, which is this: There are comparatively few planters who are provided with the present improved apparatus for manufacturing sugar. The large majority of planters, owing to pressing necessity, still adhere to the old and wasteful system of open kettles. In estimating the cost of manufacturing sugar upon the improved apparatus of the day, we find it to be very great, requiring an expenditure of not less than $20,000, an amount that would purchase a large and valuable sugar-estate. I am of opinion that, for this reason, if for no other, the manufacturing of sugar on most of the plantations should be greatly modified; in fact, I will go further, and state that, with the necessary capital and ordinary business competition of refineries located at New Orleans, it would be found more profitable to convert cane-juice into well-concentrated sirup and ship direct to market. The advantages of this system would be very great. First, the open kettles, the steam-trains, and the small evaporating-pans in use upon the majority of the plantations can make sirup equal in refining quality to that produced by the most approved apparatus, as it is only in the last stages of the operation of sugar-making that the sirup or sugar is damaged and inferior sugar made. By simplifying our present method of converting our cane-juice into sirup, say, to a density of 30° to 35° Beaumé, we would greatly lessen the expense of

manufacturing; we would require less fuel, would dispense with skilled labor, with coolers, with long delay in potting and in the purging-room, and the great loss in waste and leakage in cisterns and elsewhere. Finally, but not least, we would save much time in taking off our crops, to say nothing of the fact that our produce would be ready for market a few hours after leaving the evaporators. The only objection I can see to the adoption of this system and its practical working is the want of a market for the sirup. If capitalists would erect refineries in New Orleans, and assure planters that they would pay fair prices for their produce in this shape, I cannot help thinking it would be mutually profitable. The sugar-planter would get the full value of his produce, and the refiner would have his stock in the best possible shape to be converted into any desired quality of sugar.

To extend our sugar-interests, we must lessen the cost not only of cultivation but also of the necessary apparatus for taking off our crops, and if this system were once established it would, in my opinion, give a great impetus to business, both to refiners and planters.

SUGAR PRODUCTION OF THE WORLD.

Bouchereau, in his Annual Sugar Report for 1876–'77, quotes from an eminent English authority the following tables showing the production of cane and beet-root sugar in 1875 in the producing countries of the world:

CROPS OF CANE-SUGAR, IN ROUND NUMBERS.

	Tons.		Tons.
Cuba	700,000	Louisiana	75,000
Porto Rico	80,000	Peru	50,000
British, Dutch, and Danish West Indies	250,000	Egypt	40,000
Java	200,000	Central America and Mexico	40,000
Brazil	170,000	Reunion	30,000
Manila	130,000	British India and Penang	30,000
China	120,000	Honolulu	10,000
Mauritius	100,000	Natal	10,000
Martinique and Guadeloupe	100,000	Australia	51,000
Total tons			2,140,000

BEET-ROOT SUGAR.

	Tons.		Tons.
German Empire	346,646	Austria and Hungary	153,922
France	462,259	Belgium	79,796
Russia and Poland	245,000	Holland and other countries	30,000
Total tons			1,317,623

The following extract is taken from "A Complete Treatise on the Fabrication and Refining of Beet-Sugar," by L. Walkoff, "proprietor and fabricator of sugar at Kalinowka, Podolia, and member of several learned societies." This work brings up its statistics only to 1872–'73.

SUGAR PRODUCTION IN DIFFERENT COUNTRIES IN 1872–'73.

Countries.	Number of factories.	Weight of sugar-beets.	Quantity of sugar produced.
		*Kilograms.**	*Kilograms.**
France	487		400,000,000
Germany	304	3,050,645,600	260,000,000
Russia	318	2,140,000,000	150,000,000 (Russia and Poland)
Poland			
Austria	220	2,135,000,000	205,000,000
Belgium	117		80,000,000
Holland	29		
Sweden	6	20,000,000 (Sweden to America)	†35,000,000 (Sweden to America)
Italy	2		
England	1		
America	2		

* A kilogram is equal to 2.204737 pounds.

† This is evidently a clerical or typographical error, as it makes the sugar produced nearly double the quantity of the raw material from which it was extracted. There are no indications that the countries of which this aggregate is reported received any supply of raw material from abroad. It should, probably, read 3,500,000 or 350,000. Sugar-beets are, in many localities, raised for stock-feed.

COMPARATIVE BEET-SUGAR PRODUCTION.

Countries.	1868–'69.	1869–'70.	1870–'71.	1871–'72.	1872–'73.
	Tons.	*Tons.*	*Tons.*	*Tons.*	*Tons.*
France	213, 904	289, 324	289, 083	330, 000	400, 000
Zollverein	208, 140	217, 192	262, 987	182, 500	260, 000
Austria-Hungary	101, 602	151, 354	182, 280	162, 500	205, 000
Russia and Poland	87, 500	132, 500	135, 000	90, 000	150, 000
Belgium	37, 078	43, 552	55, 739	75, 000	80, 000
Holland, &c	10, 000	12, 500	17, 500	25, 000	35, 000
Total	658, 224	846, 422	942, 589	865, 000	1, 130, 000

LANDS IN THE SUGAR PARISHES OF LOUISIANA—CENSUS OF 1870.

Parishes.	ACRES OF LAND.		
		Unimproved.	
	Improved.	Woodland.	Other unimproved.
Ascencion	40, 091	40, 718	....
Assumption	39, 895	52, 854	1, 490
Avoyelles	38, 525	67, 952	17, 328
East Baton Rouge	50, 355	100, 084	4, 110
East Feliciana	73, 545	84, 765	23, 705
Iberia	19, 244	25, 324	36, 208
Iberville	32, 812	40, 755	103, 315
Jefferson	17, 806	12, 434	46, 757
La Fayette	58, 105	11, 732	44, 342
La Fourche	32, 820	60, 390	20, 145
Orleans	4, 603	3, 120	6, 725
Plaquemines	36, 777	15, 813	81, 963
Pointe Coupée	38, 166	48, 556	37, 078
Rapides	63, 265	145, 912	16, 989
Saint Bernard	7, 648	10, 591	12, 568
Saint Charles	15, 330	16, 734	5, 934
Saint James	26, 513	59, 762	17, 989
Saint John the Baptist	19, 880	23, 274	8, 585
Saint Landry	80, 452	141, 449	90, 877
Saint Martin's	33, 776	32, 646	37, 887
Saint Mary's	43, 564	61, 890	24, 008
Saint Tammany	1, 978	22, 083	....
Terre Bonne	36, 693	64, 913	28, 885
Vermillion	11, 524	3, 758	44, 042
West Baton Rouge	21, 628	25, 369	8, 332
West Feliciana	28, 810	62, 637	29, 277
Total	873, 805	1, 235, 515	748, 539

M. S. BRINGIER ON BAGASSE.

NEW ORLEANS, *September* 8, 1877.

DEAR SIR: Permit me to lay before you the result of a sugar-crop in Louisiana, and make upon it a few remarks.

Three hundred and seventy acres land produced 14,368,338 pounds cane, or 38,201 pounds per acre; this, put through the mill, yielded 8,021,304 pounds—55.8 pounds juice per 100 pounds cane. This juice evaporated left, in masse cuite, sugar and molasses, 1,190,987 pounds; 6,730,317 pounds water were evaporated and 2,838,430 pounds coal employed; so that each pound of coal only evaporated 2.37 pounds of water.

Masse cuite	1,190,987 pounds	= 8.29 pounds per 100 pounds cane.
First sugar	454,989 pounds	= 3.17 pounds per 100 pounds cane.
Second sugar	220,490 pounds	= 1.53 pounds per 100 pounds cane.
Molasses	515,508 pounds	= 3.59 pounds per 100 pounds cane.
Masse cuite		=14.85 pounds per 100 pounds juice extracted.

Now, 14,368,338 pounds cane contain at least 12,931,505 pounds juice. The last season the juice was very rich, and contained, at a low calculation, 18 per cent, masse

cuite; but say that only 17 per cent. of it could be obtained, then 12,931,505 × .17 = 2,198,355 pounds masse cuite should have been obtained, and not 1,190,987.

The 1,007,368 pounds loss would have cost only the fuel employed in its manufacturing to evaporate 5,738,000 pounds of water; "one pound of coal should easily evaporate six pounds of water"; 956,440 pounds of coal, or 5,314 barrels, should do the work.

This is equal to		$2,657 00
500 hogsheads, $3.50, $1,750; barrels, 700, $1.35, $945		2,695 00
Manual labor for centrifugals, &c		648 00
		6,000 00
604,412 pounds sugar, at 10 cents	$60,441 20	
402,947 pounds molasses, at 3 cents	12,089 41	
		$72,530 61
		66,530 61

This would be twice more money than was cleared on the crop. Now imagine what is the loss and at what price sugar can be made.

Very respectfully,

M. S. BRINGIER.

Mr. W. G. LE DUC,
Commissioner of Agriculture, Washington, D. C.

[From the Department Monthly Report, January, 1873.]

SUGAR-MAKING IN THE FRENCH WEST INDIES.

A system of central factories has been adopted within a few days, in the French West India islands of Martinique and Guadeloupe, for the manufacture of sugar. The system is a substitute for the long-practiced method of making the sugar by individuals upon the plantations where the cane is produced. The design is to separate agriculture from manufacture, and by a concentration of capital, somewhat upon the co-operative system, to accomplish what the isolated planter was unable to do. The experiment, made upon a large scale during a series of years, it is maintained, has fully demonstrated the soundness of the principle. The central factories, or *usines*, as they are called, are owned by joint-stock companies, by which the sugar-cane is taken from the plantation and transported to the mill upon railroads, or tramways, constructed by those companies, a certain per cent. of the value of the cane being allowed the planter, the price being regulated by the market at Point-à-Pitre at the time the cane is delivered. The system seems to have proved a success, affording to the manufacturing interest a handsome profit, and, by leaving the planter free to devote himself to his peculiar vocation, largely increasing the cultivation of the cane.

The government of the island of Jamaica recently appointed a commission to visit the French islands and inquire into the working of this central sugar-factory system. The Department of Agriculture has received, through the Department of State, the report of these commissioners. Their examinations were made during the last summer, and the results, as stated by them, are not without interest and value to the sugar-producers of the United States.

The largest central factory in the French islands is that which is commonly called the "Usine d'Arboussier," at Point-à-Pitre (Saint Louis), the chief commercial station of the island. The factory is in the suburbs of this sea-port, and is constructed upon the grandest scale, having all the improvements in machinery and the manufacture of sugar devised by modern science. The cost of it was upward of a million of dollars, and its capacity of manufacture is equal to 10,000 tons of sugar during the first six months of the year, which is the manufacturing season. The process of manufacture, as described by the commissioners, is as follows:

"The canes are brought by the planter to a siding of the main tramway on his estate. The wagon generally carries two tons of canes, and one mule on a good level ordinary tramway can draw easily two wagons. The wagon, when brought to the mill itself, conveys the canes to the rollers. The *bagasse* being elevated by power to a platform over the boilers, the juice, on leaving the mill-bed, falls through three strainers into a tank, which has a double bottom, heated by steam. It is treated here with a little bi-sulphite of lime, and is then run into a montejus. This montejus, by steam, sends the juice up to the clarifiers, where it is heated in the ordinary way and tempered with lime properly. From this it is passed to the charcoal-filters, through which it gravitates, and then passes by a gutter into a receiver. From this it is passed to a montejus and is thrown up by steam into a cistern over the triple-effet.

From this cistern it gravitates into the triple-effet, passing from the first to the second, and from the second to the third boiler, as the attendant wishes. When it leaves the boiler it is immediately passed over new reburned charcoal. It gravitates through this and falls into another receiver, from which the vacuum-pan takes it up and boils it to sugar. The first-quality sugar is generally crystallized in the pan, and is then dropped into sugar-boxes, which stand seven feet from the ground; under these boxes a little charging-vessel runs on a railway that is hung from the bottom of the said boxes, and this vessel conveys the sugar over the centrifugals, where it is cured; the molasses from this being boiled up, when found in good condition, with the sirup of the following day. When this molasses is thick and clammy it is boiled into a jelly by itself and dropped into sugar-boxes, where it is allowed to granulate for a number of days. This makes the second-quality sugar, and the molasses from this, along with the skimmings and subsidings of clarifiers, goes to make rum. The juice that leaves the clarifiers does not pass over fresh charcoal, but follows the sirup from the triple-effet, thus assisting to wash out the sweets which may have been left by the sirup.

"The weight of canes delivered at the factory last year was 75,000 tons, although it was a season of drought. The factory can receive 100,000 tons a year. Last year 5,325 tons of sugar were obtained from 68,725 tons of cane, or about 7¾ per cent. In April last the factory company declared a first dividend of 24 per cent. In other words, a net profit of $181,585 was made upon the manufacture of 68,745 tons of sugar and 182,798 gallons of rum.

"The processes of manufacture in all the factories, both in Guadeloupe and Martinique, are identical, the only difference being the adoption in the new factories of the appliances of modern science, and improved mechanical and other arrangements. The clarification of the juice, its reduction to sirup at a low temperature, the perfect crystallization and color of the sugar, and a maximum return, are obtained by repeated filtration through animal charcoal, the 'triple-effet' and vacuum-pan processes, and, last of all, centrifugal machines. In Martinique the mean weight of canes was found to be equal to 28 tons per acre, producing, say 2¼ tons of sugar, and the sugar sells at $200 a ton.

"The central factories, or usines, are represented as in the highest popular favor. Capital, both local and in France, is freely subscribed to establish new usines upon a large and extensive scale. Eight of the factories, at considerable cost, have been erected within the last two years, and others are now in process of erection. They seem everywhere, by increasing the facilities of manufacture, to have stimulated the planters to increased production of the cane. In speaking of the difference between the tillage of those who sell their canes to the usines and those who manufacture at home, it is remarked that in the one case the canes are no sooner out of the fields than the gangs and stock are at work preparing the land for the next crop, and all the fields are tidy and clean. In the other case, fields are left to take care of themselves until the crop season is over. Estates which, before the establishment of the usines, were in debt, are now said to be in a flourishing condition, and others which had almost fallen out of cultivation are now making excellent crops.

"In most of the factories hydraulic or other presses are employed for extracting the remnants of juice from the skimmings. The former are carefully returned to the clarifiers, the residuum being a hard cake, which is used for fodder and manure."

REPORT OF THE SUPERINTENDENT OF GARDENS AND GROUNDS.

SIR: I have the honor to submit the following report upon some of the operations of this division during the past year, with remarks on various subjects in response to inquiries and suggestions made by correspondents of the department.

In order to correspond with the amount appropriated for the maintenance of the grounds, and for purposes of propagating plants, it was necessary to reduce the working force previously employed. This reduction has precluded the possibility of preparing the usual number of plants for distribution, especially of those that require deliberate manipulation, such as the grafting of orange stocks, of which many thousands had to be abandoned, the propagation of olives, of Japan persimmons, grapes, fiber plants, &c.

For the same reason no additions have been made to the arboretum. The plants already established are progressing favorably, both in regard to displaying their individual characteristics of habit of growth and peculiarities of form, and the general landscape effect to be developed from their combination and grouping.

A further extension of the lake surface having been decided upon, for the better accommodation of hardy aquatic plants, a commencement was made some months ago, and the work will be prosecuted from time to time, as leisure offers opportunities from more pressing operations, until it is completed.

RUSSIAN APPLES.

Several years ago the department imported from Russia a collection of apple-trees, under the supposition that their introduction might result in adding to the list of hardy varieties of this fruit suited to the most northern regions of the country. These were planted in the grounds here, and scions from them have been freely distributed, from time to time, in various sections both North and South; some of these have already produced fruits which have been reported upon as giving promise of value. About one-half of the originally received trees have fruited here, and although many of them do not appear to reach the standard of excellence that will enable them to compare favorably with similar products here, yet there are some of more than mediocre value, and that promise to be worthy of culture even here as very early varieties. The object of their introduction, as already remarked, was for the purpose of experiment in the Northern States, so that their behavior here is no criterion of their value for the localities mentioned. Numerous calls have been made for a descriptive list of these apples, as valued in Russia, including the soils best adapted to them, their earliness, lateness, keeping qualities, and information of a similar kind, none of which would be of value to us here, even if it were practicable to procure it, which it is not. The only mode of ascertaining their adaptability or usefulness in any part of this country is to test them. Happily there is no lack of fruit-growers who are willing to make such experiments, and as soon as results are ascertained and reported, they will be published for the benefit of all.

CHINESE TEA (THEA VIRIDIS).

That the Chinese tea-plant can be grown over a large extent of territory in the United States is well known. The department has been distributing tea-plants for many years past, and in considerable quantities, throughout those parts of the country where the climate will admit its permanent growth without protection. These distributions have not been made for the purpose of testing the hardiness of the plants, as many persons at this late day seem to suppose, but with the avowed purpose of aiding in their dissemination as a means toward the production of a profitable industry, under the belief that when the principles involved in the preparations of tea came to be fully understood, it would prove to be a fairly profitable crop, quite as much so as others of the staple productions of this country. The opinion is very popular that labor is too high-priced here to enable our planters to compete with the Chinese in tea-culture; an opinion which would seem to require some explanation, when taken in connection with other popular statements, to the effect that tens of thousands of our laboring population are at present unemployed and are dependent upon charities for their bare food support. So far as the culture of the plant is concerned, its require-

ments are similar to those ordinarily given to an apple or pear orchard, or, more precisely, those of a gooseberry or currant plantation. The tea-plant is set out in rows about five feet apart, and can be cultivated as between similar lines of cotton or corn. The mere cultivation of the plant is therefore no more expensive than is that of any other farm crop, and much less than the cost of the products of the fruit or the vegetable garden.

The harvesting of the crop and its preparation for market are therefore the only points to be considered as presenting unusual, difficult, or extra expensive operations. With regard to the first, picking and gathering the leaves, it is possibly the only operation in the whole system of tea preparation where no substitute can be found for hand labor, and, upon the whole, presents no greater obstacle to profits than does that of picking cotton, gathering peanuts, or any of the smaller market fruits.

The young points of the shoots, each containing three or more leaves, are pinched off between the thumb and finger and thrown together in a bag or basket, to be conveyed to the drying-rooms. Experts have been known to thus collect twenty pounds of the leaves in a day; sixteen pounds daily per hand is less of a rarity, and twelve pounds an average. Four pounds of fresh leaves make one pound of dried tea.

Then as to drying, roasting, sifting, and the numerous other details with which tea manufacture is in some measure mysteriously surrounded, it may be stated that the philosophy (if it may be so termed) of tea manufacture is well understood; that many of the Asiatic processes and manipulations are traditional rather than indispensable, or even necessary. Others again are commercial exactions which need not be considered here, and which are only rendered necessary in order to prepare the product for distant voyages, to its manifest and acknowledged injury as an article of consumption.

Then, again, even should tea ever become an article of export from this country, and the necessity arise for preparing it for transportation, machinery can be employed for the drying, roasting, and twisting processes, as it is now used on the tea plantations in British India and in other parts of the world; and it may be surmised that improved labor-saving machinery will speedily be produced, as inventors have only to be shown what is wished to be done and they will furnish a machine to do it. The great progress that has been made in tea culture and its manufacture throughout the world during the past twenty-five years seems to be utterly unknown to, or overlooked by, many of the correspondents of the department, who doubt the propriety of experimenting with the tea-plant in the United States, although there probably never has been an introduction of a new industry in any country which had not to encounter similar doubts and prognosticated failures.

One of the most important requirements of the tea-plant, for profit, is a climate or region where spring rains are abundant; young growths are encouraged by moist weather and heat, and the number of successive crops that can be procured from the plants during the season is entirely dependent upon the number of rainy periods and the abundance of the rain-fall during the early summer months.

ACCLIMATIZATION.

The question of acclimatization of plants is frequently alluded to by correspondents of the department, in connection with the introduction of economic species and their cultivation, as subjects of commercial importance. The coffee-plant, for example, it is held by some, may be accli-

mated in Louisiana. The same opinion is held in regard to other tropical products which are now imported for use.

The process by which acclimation is to be accomplished is in a general way supposed to be through the agency of raising plants from seeds, with the hope that through successive generations the plants will gradually become adapted to the conditions surrounding them, and that by this means the descendants of a tropical species may ultimately become inured to a very different climate from that where the original was found. It has long been supposed that the sensibility of plants to cold or to heat may be modified by persistently selecting seeds from those plants that show indications of greatest hardiness, and that such changes do occur to a limited extent is quite apparent. In proof of this we may refer to the great variety of our common cultivated vegetables; of these we have early and late varieties, comprising great differences in size, quality, shape, and color, as well as in their ability to withstand sudden changes or extremes of temperature. Perhaps there is no plant that displays such diversity of forms from a common origin as those of *Brassica oleracea*, the common cabbage. Of these, the varieties are almost without number, varying in hardiness from the hardy winter-cabbages to the tender broccolies and cauliflowers. It does not appear, however, that any one of these numerous varieties is more hardy than the species; on the contrary, some of them, such as the cauliflower and broccoli, are more tender. We have in the tomato an annual plant that has been grown from seed for upward of a century in gardens, and of which many varieties exist, showing great diversity in the shape, size, and color of the fruit, as also in their periods of ripening, some being early, others late, but all being as susceptible of injury from cold as the original species.

As an example of a variety being hardier than the species, we may cite the *Magnolia grandiflora*, var. *exoniensis*, which will retain its leaves uninjured during winters cold enough to destroy young branches of the species in its immediate vicinity. The influences of climate are also illustrated in the experience of nurserymen in Scotland, who find that the *Pinus sylvestris*, when raised from seeds received from Germany, is so tender as to become "browned and scorched" during winter, and especially from the frosty breezes of early spring, while plants of the same age, the offspring of seeds gathered in the neighborhood, have a fresh green appearance all through winter and spring, and rapidly grow into sturdy trees, while the others are said to be utterly worthless in exposed situations, and only succeed in some sheltered localities. These facts, while they prove that certain changes occur, also suggest that the range of the change is limited, or at least beyond a certain limit the change is exceedingly slow. The various discoveries of the fossil remains of tropical plants in different parts of the temperate zones, together with other deductions from the geographical distribution of plants, may caution against making the positive statement that it is an impossibility for a tropical plant to ultimately change its character and habits so as to become fitted to grow in the temperate regions of the earth; but, allowing the possibility, it is one of those slow processes in nature of which history makes no mention, and, so far as it can be made useful in practical economics, is a myth.

Another series of reasonings which appear theoretically plausible, but in the main are practically unreliable, are those which proceed upon the hypothesis that a corresponding degree of latitude will have a corresponding climate in all parts of the world, or that a plant will grow equally well in all countries that have a thermometrical temperature similar to that of which it is a native. There are other potent factors

to be considered besides that of the temperature of the air, so far as it relates merely to cold or heat, such as the topographical features of a country, the amount of rain-fall, of sun-heat and light, and, what is of the most importance, the hygrometrical state of the atmosphere.

That the amount of cold that plants will endure depends upon other conditions besides that shown by the thermometer is well exemplified in the vegetation of Australia. Few, if any, of the plants of that country will stand the same amount of cold with us that they are subjected to in their native habitats. Many hundreds of Australian plants have been tried here during the past decade, and among them all, acacias, Eucalypti, Pittosporums, Boronias, &c., not one has been found to withstand 8° of frost uninjured; yet, as the following extracts will show, these plants are often subjected to 20° of frost in Australia:

In the end of April (our October), in latitude 82° south, within 4½° of the tropic, at an insignificant elevation, the thermometer stood at 20° at sunrise, and was as low as 43° at 9 p. m., nevertheless the country produced wild indigo, Mimosas, Casuarinas, and Myrtles. A degree nearer the tropic in May (our November), the thermometer at sunrise marked 20°, 19°, 18°, 16°, 12°, and on two separate days even 11°.

On the 22d of May (our November), the river was frozen, and yet herbage was luxuriant, and the country produced Mimosas, Eucalypti, and Acacias. On the 23d of May, the thermometer at sunrise marking 12°, *Acacia conferta* was coming into flower, and Eucalypti, with the usual vegetation, were abundant. On the 30th of May, at the elevation of 1,118 feet, the almost tropical *Delabechea* was found growing, with the temperature at sunrise 22°, and at 9 p. m. 31°, so that it must have been exposed to a night's frost gradually increasing through 12°. And this was evidently the rule during the months of May, June, and July (our November, December, and January); in latitude 26° south, among Tristanias, Phebaluims, Zamias, Hoveas, Myoporums, and Acacias, the evening temperature was observed to be 29°, 22°, 37°, 29°, 25°, falling during the night to 26°, 21°, 12°, 14°, 20°; in latitude 25° south, the tents were frozen into boards at the elevation of 1,421 feet; the thermometer, July 5, sunk during the night from 38° to 16°, and there grew Cryptandras, Acacias, Bursarias, Boronias, Stenochiles, and the like. *Cymbidium canaliculatum*, the only orchidaceous epiphyte observed, was in flower under a night temperature of 33° and 34°, that by day not exceeding 86°. It may be supposed that so low a temperature must have been accompanied by extreme dryness, and such appears to have been usually the case; nevertheless, it is not always so, for it was found that on the 22d May, when the hygrometer indicated nearly saturation, the grass was covered with hoar frost, and at sunrise the thermometer was 20° under canvas and 12° in the open air. On the 5th of July it rained all day, and the tents were "frozen into boards" next morning, the thermometer having sunk during the night from 38° to 16°.

Undoubtedly this power of resisting cold is connected with the very high temperature to which Australian vegetation is exposed at certain seasons, which so thoroughly ripens and hardens growth as to fortify against the evil results that follow extremes of heat or cold on succulent vegetation. The temperature of the soil has also an important controlling influence in the cold resisting-power of plants. Unless a constant supply of moisture is furnished by the roots, the branches will dry up and shrivel under the influence of cold drying currents of air, and when the temperature of the soil is low, the activity of the roots is correspondingly decreased, and therefore they are unable to replace the losses of evaporation from the external surfaces of the plants. The winter temperature of the soil in which plants are growing has a potent influence on their cold resisting-powers; hence the value of the applications of manure and similar porous materials over the roots of plants in winter.

EUCALYPTUS.

The general interest in the introduction of this genus of Australian trees is still maintained, and it is almost a daily occurrence to reply to inquiries relating to their culture, value, climatic range, &c.; and while the *E. globulus* is the species about which the greatest expectations have been

raised, latterly the subject seems to have taken a wider range, and information is sought regarding the values of other species of this large family of trees.

The *E. globulus* has been brought more especially into notice on account of its rapid growth, which was the supposed reason for the power attributed to it of destroying the malarious agency which is considered to cause fever in marshy districts, but so far as mere rapidity of growth is concerned, or the influence that an abundance of healthy, active foliage exerts in absorbing moisture from the soil, the *Eucalyptus* presents no special peculiarities over those inherent in many other trees and plants that are rapid in growth and furnished with a profusion of ample-sized leaves.

It may therefore be instructive to recite the accorded values of other species of the *Eucalyptus* genus, especially as some of them are alpine in their native habitats, and may prove hardy in higher latitudes than those that limit the *E. globulus*.

It is noteworthy that in Australia the *E. globulus* does not hold the highest position in regard to anti-malarial properties, although its products are highly esteemed. The supposed sanitary properties of these trees are, in their native country, referred to the chemical constituents peculiar to the genus, regardless of the rapidity of their growth or the dimensions they attain.

In a paper* upon *Eucalyptus* read before the Royal Society of Victoria in 1874, and which is published in the official catalogue of the Commissioners to the Centennial Exhibition for Victoria, Australia, there is much valuable information regarding the properties and qualities of various species of the *Eucalyptus*, and from which the following extracts of particular interest with reference to the introduction of these trees into this country are taken:

In many places on the continent of Europe, and elsewhere, experiments have been made to acclimatize our *Eucalypti*, more especially the "globulus," or blue-gum species.

The rapidity of its growth, its pretty ovate and, afterward, lanceolate leaf, its early maturity, together with its power to absorb considerable moisture and to permeate the air with its peculiar odor, led to the belief that this tree, attractive in itself, exerts a beneficial influence upon malarious districts. But this species, if considered apart from its congeners, does not supply sufficient information so as to arrive at anything like a satisfactory answer to the question—

Is the *Eucalyptus* a fever-destroying tree? In the consideration of this question we must regard the whole of the *eucalypt* vegetation.

If we journey from Melbourne, or from other centers of population in any part of Australia, or diverge to any point of the compass, we immediately observe the *Eucalyptus*, which is seldom absent until we again enter some city or town; in fact, four-fifths of Australian vegetation consists of the *Eucalyptus*.

In the consideration, therefore, of its climatic influence, or of its health-producing power over that of all other vegetation existing in other countries, we are able more efficiently than elsewhere to deal with the subject. * * * *

Australia on the whole may be said to be pretty free from virulent endemic or miasmatic fevers, and the latter may be said to exist only as the *Eucalyptus* recedes.

The physical geography of Australia does not differ in its general outline from that of other countries. We have mountains and valleys, high ranges and extensive plains, rivers and creeks, and in general structure, character, and composition, in geological sequence, and in physical and palæontological relations, the rock formations are in all respects analogous to those of other regions.

But in the *Eucalypti* we have a vegetation absolutely Australian; if, therefore, we possess in a high degree an immunity from fever maladies, can it be traced in any way to this genus of plants? * * * * * * * *

The physical properties of all *Eucalypts* are, that they cast their bark; that the leaves are ever green and have translucent cells, in some species visible to the naked eye; that the petiole is half twisted, so that the plane of the leaf is parallel to the axis of the tree, thereby allowing free action to the light and heat of the sun *on both sides;* also the roots are dispersive and drain water largely from the soil.

* This paper was prepared by Mr. Bosisto, M. P., one of the commissioners.

The chemical contents of a *Eucalyptus* tree are neither poisonous nor virulent. Besides possessing those invariably met with as general constituents of ligneous vegetation, there is a *tannate gum resin*, a *volatile acid*, and a *volatile oil*, peculiarly of *Eucalyptic* origin.

The first two are to be found in most parts of the tree, but the latter only in the leaves. Now, it is in these three bodies, I think, that we have the key to the question before us, and I conjecture that apart from these no trace can be found of the power of the *Eucalyptus* to oxygenate the air beyond that which is possessed by other kinds of vegetation. If the principles of these bodies are retained in the tree until set free by the art of man, then further investigation is useless; but if one or more are given up freely by the natural forces of the tree, or by the aid of light, heat, or electricity as existing in the atmosphere, or by some or all of these forces in combination, then there is every reason to pursue our inquiries. The question then arises, have we any proof that these volatile bodies are set free in the air by the forces of the plant in union with atmospheric agencies? If we have, when does it take place? What is the quantity? What is the probable sanitary effect?

Before taking up this question, I think it but right to mention that my operations on the *Eucalyptus*, both as to its solid and volatile contents, for technical and medical purposes, have extended over many years, and that they have been conducted on the living plant in its forests and in the desert scrub during all seasons of the year, and that the apparatus employed operated on four tons of material daily.

The following eight may be taken as representative or type species of *Eucalyptus*: 1. *Viminalis*, or manna-gum; 2. *Odorata*; 3. *Rostrata*, or red gum; 4. *Obliqua*, or stringy bark; 5. *Sideroxylon*, or iron bark; 6. *Globulus*, or blue gum; 7. *Oleosa*, or mallee; 8. *Amygdalina*, or peppermint.

The first two, *Viminalis* and *Odorata*, represent those species of the Eucalypti which yield a small percentage of volatile oil. The four following, the red gum, the stringy bark, the blue gum, and the iron bark, represent those species which gradually increase in percentage of oil until it attains a fair medium standard; and the last two, the mallee and the peppermint, are those which represent the maximum.

The following is the illustration: From 1,000 pounds weight of fresh-gathered leaves, attached to very small branchlets, *Odorata* yields 7 fluid ounces; *Viminalis* yields the same; *Rostrata* yields 15 ounces; *Obliqua* yields 80 ounces, or 4 pints; *Globulus* yields 120 ounces, or 6 pints; *Sideroxylon* yields 160 ounces, or 10 pints; *Amygdalina* yields 500 ounces, or 25 pints.

No Eucalypti exceed the *amygdalina*, and no vegetation contains so much volatile oil in the leaves as is found in most of the species just named. These eight species not only represent the oil-yield from the minimum to the maximum, but also the volatile acid and the tannate gum-resin, as well as the locality, from mountain to desert.

First, then, concerning the volatile oil. If we break up a leaf of any of the Eucalypti during any part of the year, its usual aroma is present, and the oil-cells appear the same in condition; but when submitted to a practical test, the quantity is found to vary. Soil or locality does not appreciably affect the quantity obtained from a species when operated upon during the same season of the year.

The range of those species represented in the *viminalis* and *odorata* as yielding oil sparingly is limited, in comparison with those producing larger supplies. These have a wide range. * * *

The *Eucalyptus amygdalina* is a tree varying from that of an ordinary willow to that of the giants of the forests, some being over 350 feet in height; it occupied chiefly the higher portions of undulating forest-land and the sides of the ranges, and does not extend over 100 miles inland; the ground where it grows retains a little moisture throughout the summer months, the roots run chiefly lateral, and are seldom lower than three feet from the surface; they are surrounded with a soil evenly cool, but the temperature of the air has its usual summer range. During these months the supply of oil from week to week is very even, but as the cooler or winter months approach, the ground becoming moist from rain, and the temperature of the air lower, the supply of oil falls off.

The mallee scrub is the opposite of all this. Properly this scrub consists of three species, the *oleosa*, the *dumosa*, and the *socialis;* but I have brought them under consideration as one, the *oleosa*. They are the dwarfs of the Eucalypti, but seldom growing higher than 25 feet. They occupy a flat, dry, hungry country, with but little growth of grass under them. There is little rain, but when it comes, it is generally in torrents. The soil is a reddish sand in combination with salt clay. This, during the long droughts, becomes exceedingly hard—so much so that a pickax is required to turn the soil. The roots run somewhat in a horizontal direction, and the rootlets spread out, traveling downward; and as the salt water is to be obtained always at from 25 to 40 feet, they are found resting on the moisture of the salt soil just above the sandstone rock, which generally commences about 12 feet above the salt spring. The temperature of the surface ground, and also that of the air, is very high throughout the summer. The leaves supply a greater amount of oil during the winter or rainy season than during the hot or summer months.

We have, therefore, a *Eucalyptus* vegetation charged to its utmost during summer around all our populated districts, and we have another charged in like manner during winter; in other words, as midwinter approaches, the coast species are increasing in volatile products and the others are decreasing. * * *

So far our evidence of oil-evaporation may be stated thus: that the desert scrub-gums, after a winter of average rain-fall, supply the air with a continuous and even quantity of aromatic vapor, and keep up a vigorous vitality throughout the summer or dry season; and that a short season of rain and a long dry one diminish the formation of oil, and so lessen the exhalation; on the other hand, the seaward species increase their quantity after a short winter.

Next concerning the volatile acid.

Eucalyptus leaves (especially those of some species), when submitted to the process of ordinary distillation by steam or water for volatile oil, throw off a volatile acid which greatly affects the copper head of the still—so much so, that on lifting it off we find the under surface covered with what is like a coat of slate-colored paint. After the copper head has been used for some time, this paint-like substance dries into scales having a slate-pearly appearance.

If the distillation has been by water, and the mother-liquor remaining in the still is subjected to a little evaporation, this acid may be detected in the vapor by litmus-paper. Should the evaporation be carried to further concentration, the acid aroma becomes palpable around the locality of operation, persistent, and very refreshing; in short, there is no expelling this acid out of the gum-resinous extract forming in the pan. The aroma of the acid may be detected in the air along with that of the oil when traveling in the bush.

The special features of this acid as existing in all Eucalypts are, that in those species supplying oil most abundantly the acid is *not so prominent* as it is in those yielding the medium quantities, while those species which contain oil sparingly contain also but little of the acid. In like manner this applies to the resin bodies. And these facts are worthy of particular note, as they go to show, first, that those species yielding largely of oil are not so abundant either in resin or acid, and that those of medium oil-yield are well charged with both. In proof of this, the *amygdalina*, our largest oil-producing species, during its active period of supplying the volatile oil, does not throw off much resin; but when it begins to lodge in the interstices of the bark and wood and exudes outwardly, the oil is diminished in quantity in the leaves.

The *globulus*, or blue gum, yields a continued supply of oil and acid throughout the year; but when the tree is extra resiniferous, the acid is abundant and the oil small in quantity.

The *rostrata*, or red gum, produces a very small quantity of oil, but the volatile acid is very abundant—so much so, that the red-gum wood owes its aroma entirely to this acid.

The *sideroxylon*, or iron bark, are trees of good dimension, and supply oil abundantly, but the leaf-surface on each tree is small in comparison with other species. Here the resin is so abundant that its enormous bark is everywhere studded with gum-resin.

All these characteristics, and others of like nature, point to the following conclusion: That the volatile oil is the base of the other products peculiarly of eucalyptic origin, and for the following reasons: that those species which are great in the production of oil supply it vigorously to the atmosphere, giving but little time for the formation of substances such as resins and acids, requiring the absorption of oxygen by the leaf to form them; on the other hand, those species less vigorous in oil-production allow time for the purpose, hence they become well stored with resin and with the acid. * *

When we consider the extent of this vegetation, we cannot arrive at any other conclusion than that the whole atmosphere of Australia is more or less affected by the perpetual exhalation of these volatile bodies.

The researches of Schonbein and others relating to the change the oxygen of the atmosphere undergoes by electricity and by other known oxidizing agents, suggested a similar province for the aroma of plants and flowers, and Dr. Andrews, of Edinburgh, states that "volatile oils, like phosphorus, have the power of changing oxygen into ozone while they are slowly oxidizing." Unless some such change took place in the air, the aroma of the oils of the Eucalypti would be always present, and to such an extent as to become quite unpleasant.

Ozone, or whatever may be the active substance in the atmosphere, is known to act in a similar manner on iodide of potassium and some other chemicals; and Dr. Day, of Geelong, whose researches on this subject are well known, has demonstrated that the *Eucalyptus* oils absorb atmospheric oxygen, transforming it into peroxide of hydrogen. If the change effected be the production of ozone, and the latest known experiments on the subject, confirmed by Dr. Andrews, appear to leave no doubt that this is the case, then another link is added to the evidence that the *Eucalyptus* vegetation has an important action on climatic influences. Dr. Andrews remarks that "no connection has yet been proved to exist between the *amount* of ozone in the atmosphere and the occurrence of epidemic or other forms of disease"; but remarks, "its absence

from the air of towns and of large rooms, even in the country, is probably the chief cause of the difference which every one feels when he breathes the air of a town or of an apartment, however spacious, and afterwards inhales the fresh air of the open country." Let a small quantity of any of the *Eucalyptus* oils, but especially the oil of *Eucalyptus amygdalina*, be distributed sparingly in a sick chamber, or over any unpleasant substance, or add a small quantity to stagnant water, and the pleasure of breathing an improved air will immediately be manifest. The application of this to the climate of Australia has great force, for it is acknowledged that we possess about us, both in bush and town, a large amount of active oxygen, made frequently doubly so by our vigorous vegetation. * * *

The various fever types as found existing among us at times appear malignant, arising either from importation or from the existence of bad sanitary regulations; but medical testimony is that their virulence is meteor-like, "dies at its opening day." No credit can be taken for any improved sanitary condition of our surroundings by ourselves in our towns and cities. The influences operating there *entice* the poison fever germ to fructify and abound. The evidence is in favor of the *Eucalyptus* being a fever-destroying tree.

Other properties and uses of the genus *Eucalyptus* may here be noticed. The remarkable solidity, hardness, and durability of the timber of some of the species is well known. The large proportion of potash, amounting to 20 per cent., in the ashes of these trees has been pointed out by Baron Von Müeller. The barks of *E. rostrata*, *E. obliqua*, *E. goniocalyx*, and *E. corymbosa* are used for making paper. The barks of many species are used extensively for tanning. A substance called Australian manna is yielded by *E. mannifera*, *E. viminalis*, and other species. This manna occurs in small, rounded, opaque, whitish masses, with an agreeable sweetish taste; it contains somewhat similar constituents, and has similar action to the ordinary manna, and exudes in large quantities through punctures or wounds made in the young bark. Another product of great importance is the essential oils. These oils generally have a camphoraceous smell, the odor differing in the various species; that from *E. citriodora* has a pleasant citron-like flavor. The oil from *E. oleosa* is used as a solvent for resins in the preparation of varnishes. The oils of *E. amygdalina*, *E. globulus*, and *E. citriodora* are used for diluting the more delicate essential-oils used in perfumery. These oils contain a substance called Eucalyptol, a liquid body, having chemical characters resembling camphor.

The febrifugal properties of the bark and leaves of *E. globulus* have been noted by many medical practitioners. Although careful examination of the bark and leaves has proved that neither quinine nor the other alkaloids of Cinchona bark exist in the plant, yet it is admitted to possess antiperiodic properties, which are supposed to be due to the presence of Eucalyptol.

Finally, cigarettes made of *Eucalyptus* leaves are reputed to be useful in bronchial and asthmatic affections. Considering the rapidity of growth, the value of the timber, the healthy emanations from the foliage, the commercial importance of the essential-oils, and the beauty of the different species of the genus, it must be conceded that the *Eucalyptus* is one of the most important family of forest trees known at the present time, and that they should be extensively planted wherever climatic conditions are favorable to their growth, with the further reminder that the *E. globulus* need not be taken as a criterion of the hardiness of the genus in low temperatures, since the more alpine species are known to flourish where the *E. globulus* has failed.

The purpose of these detailed remarks upon the genus is to show that the supposed sanitary value is not confined to one species, but that the whole family are possessed of oil-bearing leaves, and that, therefore, further experiment with the hardier species may be profitable.

ORANGES.

The following notes on oranges are taken from a valuable paper by John R. Jackson, of Kew, which appeared in the "Garden:"

Regarding the early history of the orange, a good deal rests upon what is the true and original form whence sprung our numerous cultivated varieties. All those included as bitter and sweet oranges are referred by some botanists to *Citrus vulgaris* (Risso), a native of Northern India; indeed it is supposed that a wild form which occurs in Gurhwal, Sikkim, and Khasia is the origin of all our cultivated forms. It has further been considered that the Citron, Lemon, Lime, and Shaddock, and even the Orange, are all referable to a species indigenous also to the forests of Northern India, in the valleys of Kumaon and Sikkim, and perhaps specifically identical with *Citrus medica* (Risso). Upon the hypothesis of this being the original form of the now widely-cultivated orange, we learn from Theophrastus that it was plentiful in Northern Persia, and cultivated by the Jews in Syria during the Roman dominion. Though it seems that the fruits found their way into Rome at a period anterior to the Christian era, the tree appears not to have been successfully cultivated in Italy till some time in the third or fourth century. However widely diffused the plant may have been in Western Asia, recent travelers have not found it in a wild state in Persia.

In China it is cultivated, having no doubt been introduced from an early period. At the present time the growth of the orange extends over all warm countries, and it is cultivated successfully in many colonies. In America it yields most abundant returns.

Orange (*Citrus vulgaris*, Risso). Under this head may be placed both the Sweet and the Bitter orange. By those who do not so class them, however, the former is often referred to *C. Aurantium* (Risso) and the latter to *C. Bigaradia* (Duhamel). The Sweet orange has ovate, oblong, acute leaves, the edges somewhat serrated, and the stalk with larger or smaller wings, the presence of which is a characteristic mark of the genus. The white, fragrant flowers are too well known to need any description. The principal difference in the numerous varieties described is in the form of the fruit; thus we have the ordinary Sweet or Saint Michael's orange, with its somewhat small, golden-yellow fruit, divided into from nine to eleven cells, and containing roundish seeds. This is one of the most extensively cultivated varieties, on account of its great productiveness. The tree is said, however, not to come into full bearing until it attains the age of twenty years. The Blood or Malta orange has a fruit which is round, somewhat rough, and very thin-skinned, and as it ripens becomes of a reddish-yellow color, the pulp itself being tinged with red, which deepens as the fruit matures. This variety has very few seeds, which are barren. It is a choice variety, the pulp being very sweet and juicy. Another choice variety is the Mandarin orange. This bears a small fruit, somewhat flattened, with a very thin rind which separates from the pulp as the fruit ripens, and when fully ripe hangs loosely around it. It is of a very rich and sweet flavor. This variety is extensively grown in China, where the fruits are much prized as presents to the mandarins. It has been introduced in comparatively recent years into Malta and St. Michael's. The Mandarin orange was at one time considered a distinct species, under the name of *C. nobiles* (Lour). It seems, however, to be simply a variety of the common orange, as is also the Tangerine, which produces small, somewhat flattened fruit, with a thin rind, and a sweet, delicious, fragrant pulp.

Among bitter oranges the most important, either in a commercial point of view or on account of the peculiarity of their fruits, are the following: The common bitter or Seville orange (the *Bigaradier* of the French); a fruit with a thick rind, and a rugged, uneven surface of a reddish orange color. The rind, flowers, and leaves are more distinctly aromatic than those of the sweet orange, and the pulp has an acid, bitter taste. It is the fruit of this variety that is used for making marmalade, and the peel is used for candying and making medicinal tinctures. The rind is removed from the ripe fruit in long, spiral strips by a sharp knife—if removed without the white under-skin it is the more valuable. The tree is of a small size, and is extensively cultivated in the warmer parts of the Mediterranean region, more particularly in Spain.

This variety and the Chinese Bitter orange, or Chinois (the *Bigaradier Chinois* of the French), are perhaps the only two cultivated purposely for the fruits. This latter has a thick rind, the fruit is small and spherical, and is often preserved in sirup. Many of the fruits of the bitter oranges are very singular in form, notably the Horned variety (*Bigaradier à fruit corniculé*). This variety grows into a good-sized tree, and is cultivated in the south of Europe as much for the sake of its fragrant flowers as for the fruits, which were at one time, and may be still, used for flavoring or seasoning meat. A double-flowered variety, the *Bigaradier a fleur double* of the French, comes nearest perhaps to the Horned variety, resembling it in the form and size of the tree. The fruit varies in form, but is mostly double, containing, so to speak, one within another. The flowers are gathered for the sake of their perfume.

Another variety, *Bigaradier violette*, bears leaves and flowers of two different colors on the same plant, some being of a violet hue and the others of the ordinary color;

the fruits also, in an immature state, have a violet tinge. The small-growing myrtle-leaved orange is also a variety of this class.

Lemon (*Citrus limonum*, Risso; *C. medica* var. of some authors). Of the Lemon a very large number of varieties are in cultivation. In all, however, the fruits contain a very acid pulp, distinct from any other species or variety of the genus. A very large-fruited variety is described as having been introduced and much cultivated in Jamaica, from a single fruit of which a pint of juice has been obtained. The common lemon is a tree from ten feet to fifteen feet high, specially cultivated as an article of commerce on the coast of the Mediterranean, between Nice and Genoa, as well as in Sicily, Calabria, Spain, and Portugal. As seen in cultivation, the lemon, unlike the orange, is of irregular growth, with sparse foliage. The flowers are partly hermaphrodite and partly unisexual, and the corolla is purplish on the outside and white within. Their fragrance is more delicate than, and not so clinging as, that of the orange. The trees blossom during a great part of the year except the actual winter. The lemon assumes many peculiar forms, among the most singular of which is the Fingered Lemon of China.

This fruit grows to a large size and is almost solid, with little or no pulp; at the apex of the fruit the segments become absolutely divided into five or more long, cylindrical lobes, hence the name. Among those noted for their free-flowering and abundant fruiting is the Clustered Lime or Lemon (*Limonier à grappes* of the French). The leaves of this variety are oval, oblong, and the flowers, which are borne in corymbs, are succeeded by clusters of roundish-oblong fruits often somewhat warted on the surface, the rind being thick and shining, and the pulp very acid, and containing only a few seeds. This variety produces fruit abundantly during a great part of the year, and is cultivated largely in Southern Europe.

Citron (*Citrus Media* (Risso) *Cedrat* of the French). This species is now usually retained as the origin of all the fruits previously considered. The Citron occurs in fewer varieties than either the orange or the lemon. The most common is the large citron (*Cedratier a gros fruits*); in this the leaves are thick, oval, oblong, and of a glaucous green, and the flowers are large and white and very numerous; the fruit also is very large, covered with a very thick, irregular, or wrinkled rind, at first of a reddish-purple color, becoming green as the fruit enlarges, and finally changing to a coppery hue.

It is for its thick rind that the citron is valued for the purpose of candying or preserving in sugar for use in confectionery; for this purpose the peel is salted and shipped to various parts. The fruits themselves, which often weigh several pounds, are seldom eaten raw. The citron appears at the present day to be nowhere cultivated extensively, the more prolific lemon-tree having generally taken its place. It is, however, scattered along the Western Riviera, and is also grown on a small scale about Pizzo and Paola, on the western coast of Calabria, in Sicily, Corsica, and the Azores.

Bergamot (*Bergamottier* of the French). *Citrus Bergamia* of some authors, though modern botanists consider it not sufficiently marked to make it a distinct species from those preceding. It is a small tree, in flowers and foliage not unlike the Bitter Orange; the fruits are nearly spherical or somewhat pear-shaped, very often crowned at the apex by the persistent style; they have a smooth, thin skin, of a pale-yellow color, and this skin contains a large quantity of essential oil, of a peculiar but well known fragrance. It is for this oil (the oil of Bergamot of the shops) that this variety is valued, being cultivated on low grounds near the sea at and in the neighborhood of Reggio, in Calabria, where lemon and orange trees are often mixed with it. The essential oil is expressed from the fruits by specially constructed machinery by which the fruits are made to revolve in a kind of dish or saucer, at the same time coming in contact with a series of metal ridges, which fracture the rind and thus set free the oil. From 2 ounces to 3 ounces of this oil is so obtained from every 100 fruits, and about 7,000 fruits are thus treated by a single machine in one day. After the oil has been extracted the fruits are again pressed for the sake of the acid juice contained in the pulp, which is concentrated and used in the manufacture of citric acid, and the residue, after the final extraction of the oil and juice, is used as a cattle-food. The oil is always known in commerce as essence of Bergamot, and is imported chiefly from Messina and Palermo. Its principal use is in perfumery. Like all other fruits of the orange tribe the Bergamot has its varieties with fruits of singular formation. One, for instance, in which the fruit is flattened to where there is a circular opening, discloses a number of irregular prominences. On cutting one of these fruits across a series of about twenty cells filled with pulp are seen around the circumference, and in the center a number of cells agreeing with the external prominences.

Lime (*Citrus Limetta*, Risso). The chief use of the Lime is for the juice, which has a great reputation as an antiscorbutic; several varieties are cultivated.

Shaddock (*Citrus decumana L.*). The fruits of the Shaddock are known under distinct names, according to their size; thus, a full grown fruit is very large and weighs from 10 to 20 pounds; they are then called Pompelmousses or Pampelmousses, while those of the smallest size are known as Forbidden Fruit or Pomeloes.

Citrus Japonica (Hib.) is a native of Japan, the fruits of which are about the size of a large cherry and quite spherical, with a thin rind, and a very sweet, agreeable pulp.

It is known as the Kumquat, and the fruits preserved in sirup are often exported from that country.

From notes relating to the preparation, and the commercial aspects, of the productions of the Citrus family it is remarked that of all scent-yielding plants none has a value at all equal to that of the Citrus tribe. The orange is a mine of perfume in itself. The blossoms yield, according to their mode of treatment, two distinct odors, one having the true scent of the flower, the other a scent called neroly. Orange-peel, too, furnishes a delightful perfume, and the leaves give a scent inferior only to the true neroly. Orange stocks are raised from seeds or pips, and in the third year they are grafted. In the fifth year they are planted where they are to stand. The soil should be well prepared, inasmuch as fifty years, nay, even a century afterward, the results of good early treatment will be apparent.

Orange-trees require from ten to fifteen years to reach a good size, but they will produce both flowers and fruit in four or five years. When in full vigor, each tree yields on an average 25 pounds weight of blossoms annually. At Nice a public market exists for the sale of orange-blossoms during the season when the trees are in bloom. The bitter-orange flowers bring six cents per pound; those of the sweet orange four cents. A ton of flowers will, by means of distillation, yield, say, 40 ounces of neroly otto, worth $120, and the residuary water—orange-flower water—about $25. Orange-flower fat, or butter, and oil are manufactured to a large extent by the enfleurage and macerative process. It requires about eight pounds of blossoms to enflower one pound of grease, the operation being divided into about thirty repetitions of a small quantity of flowers over or in the same grease. By digesting this orange-flower grease in the proportion of six pounds to eight pounds in one gallon of rectified alcohol, there are obtained the extracts of orange-flowers, a handkerchief-perfume which is surpassed by no other scent.

The *Citrus bergamia*, or bergamot lemon, is a plant of great value as a scent-yielder; its perfume is so much in demand that its annual production in Italy has never satisfied the market. The Messina dealers and their allies carefully adulterate the true bergamot-otto with lemon-otto. The name of this variety is derived from the city of Bergamo, in Lombardy, from whence the otto was first sold. The otto of bergamot of the finest quality is that which is expressed from the fruits; but about four-fifths of it in the market is a distilled product or one expressed from the rasped rind of the fruit. About 40,000 pounds weight of otto of bergamot are annually imported into England. In the little island of Montserrat the *Citrus limetta* grows most prolifically, and in almost an indigenous manner. One of the orange-orchards there consists of 500 acres, each acre containing 200 trees. They come into full bearing in seven years from the seed; they flower more or less whenever they get heavy rain, and the fruit ripens in about four months after the flowers appear. They fruit all the year round, but the chief harvest is from September to January. About 90,000 pounds weight of otto-lemon is imported into England. The otto of lemon in the market is principally from Messina, where there are hundreds of acres of lemon-groves, and the extraction of the ottos of lemon constitutes the chief industry of Sicily, particularly in the vicinity of Palermo. There is ample room in European markets for all that is produced here, as well as for all that may be produced in other countries.

The following remarks upon orange-growing in the Azores may also afford useful hints in this connection:

The culture of oranges has considerably increased during the last thirty years at St. Michaels. In former days the plants were left unsheltered; they were planted at great distances from one another, thus forming magnificent trees, covering a large surface of ground, one of which would bear from 15,000 to 20,000 oranges. A heavy stone was laid on the top of each tree to force the branches in a lateral direction and keep them low so that the wind might not destroy them. This system has been entirely abandoned, as it did not prevent the trees from being uprooted by the severe storms which blow from the Atlantic. The idea was then adopted of planting the orange-trees in small lots and surrounding them with trees of larger growths; but it was found that these overshadowed the oranges and prevented their ripening. In 1845 the system was introduced of inclosing the plantations by stone walls and with the best results. These walls are from 10 feet to 15 feet in height, inclosing spaces from 150 feet to 200 feet square. In the larger inclosures the average crop on each tree does not exceed 600 fruits, while in smaller spaces the average is from 2,000 to 3,000 fruits, showing how much good shelter and care will do towards increasing the crop. The ground of the plantations is well plowed and tilled for four or five years. After that it undergoes a superficial plowing twice a year, and is occasionally sown with a green crop, which is slightly covered in by shallow plowing. Every year the dead wood is cut out and the shoots thinned; but, as a rule, the orange-tree is never pruned. In dry seasons the ground is well watered if the supply be near and sufficient in quantity.

There are six principal varieties of sweet oranges cultivated in the Azores. The common one is of middle size, slightly acid, and very sweet-scented. The skin is thin and adheres well to the fruit, becoming a little thicker towards the end of the season. The *Comprida* is more aromatic than the preceding one, and also more acid. This tree is rarely loaded with fruit. Under the name of the Silver Orange is designated a much smaller one, with very firm flesh, extremely fine skin, and greenish-yellow color. The *Selecta*, or choice orange, is large, of first-rate flavor, little acidity, and of a deep yellow color. It has scarcely any pips, and does not ripen until April, which gives it a higher value. The Ombigo is flatter, and sweet, while it furnishes the largest crop of all. Finally comes the Mandarin, which differs little from the same variety grown in Malta. The fruit, as a rule, enters into its maturity in October, but the best varieties are not gathered until January, the season terminating in May. The trees are increased in a curious way. The mode of propagation was derived from the Chinese, and has been much in use of late years. A branch of the diameter of 4 or 5 inches is chosen, around which a circular incision is cut. Around this straw matting is wound in the shape of a funnel and filled with beaten earth from the middle of May to the middle of June. Roots soon begin to push, and by the following winter it is provided with sufficient to support it when detached from the parent stem.

The young plant thus obtained often bears fruit at the end of two or three years. Formerly grafting was employed, and is still used, but it is somewhat out of fashion, on account of the relative slowness with which trees "worked" by it come into bearing. It is, however, asserted that the trees to which it has been here applied give the best fruit, and last longer than the others.

The oranges are gathered with care and carried to the packing-shed, where each fruit is separately wrapped in a dry maize leaf, and put in the box. The shape of these boxes has been entirely changed of late years; formerly they held from 700 to 900 oranges. Thin flexible planks formed a convex covering, without any solidity, and containing in the lid almost as many oranges as in the box itself. This curious arrangement was explained by saying that the air circulated more freely between these planks, and that this was necessary to the preservation of the fruit; but really the custom arose from the wish to escape the tax imposed upon all exports, which only prescribed the dimensions of the lower part of the case. The growers made the box of the right size and then surmounted it with an enormous cover. Thus formed, they would not pack well and the fruits were crushed. The boxes are now made rectangular, divided into three compartments, are about a yard in length, and hold only half of what the former ones did. The expenses of gathering, carrying to town, storing, packing, embarking, including the case and maize leaves, amount to 65 cents a case. As for the price of a box of oranges, sometimes they are sold at St. Michaels, when just gathered, for $5 the 1,000, packing and transport being at the cost of the buyer; other times they have sold as low as $2. Of late years about 600,000 cases are yearly exported to England. Steamboats engaged in this service make eight voyages to England from the middle of November to the end of April; each carries about 5,000 cases.

THE PYRETHRUMS AS INSECT-DESTROYERS.

As information about the *Pyrethrums* is frequently sought by correspondents with a view to their cultivation and preparation for insecticides, the following notes collected on this subject are here introduced:

Several species of *Pyrethrum* have attained reputation as insect-destroyers. The *P. carneum* and *P. roseum* have both proved to be excellent in this respect. About 30 years ago the flowers of these were introduced in a powdered form under the name of "Persian Insect Powder." The flowers of *P. cinerariæfolium*, a native of Dalmatia, have been similarly employed under the name of "Dalmatian Insect Powder." A test of the value of these powders is thus described:

In order to test the effect of the different insect-powders, I sprinkled some flies with the powders, and took the length of the time required to kill the flies as the measure of the value of the powders. When a house-fly was placed in a small flask, sprinkled with four grains of insect-powder, if the powder was very powerful, there was considerable stupor at the end of one minute, followed by the death of the fly after two or three minutes. The commercial insect-powders behave differently in this respect; some of them corresponding completely to the above standard, while others, although they quickly stupefied flies treated as above, required fifteen to thirty minutes to kill them. My first test was made by some powder of my own preparation from the Dalmatian

species. The druggists in Vienna purchase the whole flowers yielded by the uncultivated Dalmatian *Pyrethrum cinerariæ folium*, and the powder they supply is a very energetic preparation. It is noteworthy that both these entire flowers, and the powders prepared from them, after being kept six years, do not suffer any particular loss of activity. I have found the powder of the flowers of *P. cinerariæ folium* very active. *P. roseum* appeared to be slower in its action, which I ascribe to the circumstance that the single flowers are much more powerful than the double flowers, which appear to have little activity. The double flowers occur in *P. roseum* in much larger proportions than in *P. cinerariæ folium*, and to this fact I consider the greater activity of the latter due. The fresh (undried) flowers of both these *Pyrethrums* will kill flies, but very slowly. The plant itself, powdered, apperared to be quite inactive. In a similar manner I have tested the powdered flowers of several Austrian *Compositæ*, and I have found the following to be quite inactive in this respect: *Chrysanthemum leucanthemum, C. coronarium, Anthemis arvensis, A. cotula, A. tinctoria, A. nobilis*, and *Inula pulicaria*. The flowers of *Tanacetum vulgare* and *Pyrethrum corymbosum* appear to have a very slight stupefying effect. Of all the Austrian indigenous *Compositæ* tried, only the powdered flowers of *Pyrethrum parthenium* and *P. inodorum* exercised a stupefying influence upon flies, and that only after the flies had been dusted from one to two hours; their value, therefore, as insecticides is very slight.

In a scientific aspect it is, however, interesting to notice that up to the present time the action obnoxious to insects has only been observed in the genus *Pyrethrum*, while from other composites approaching very nearly to that genus the property is absent.

The seed of *Pyrethrum* are sown in spring; the plant is quite hardy, and blooms abundantly the second year from seed. The powder is made from the half-opened flowers, gathered during a dry day, and dried in the shade under cover. It is pulverized in a mortar, sifted and stored in bottles for use. It is largely cultivated in Russia, where it is used in immense quantities. An acre of ground in these plants will yield about 100 pounds of the powder. As it requires a considerable amount of labor and manipulation to gather, dry, and prepare the flowers, its culture is not considered profitable except in countries or localities where labor is very cheap and plentiful.

WITLOOF OR CHICORY.

Among the seeds lately distributed by the department, there were some packages of a new vegetable or salad plant, known as witloof, which has been the occasion of repeated inquiries as to its use and value.

The witloof—the literal meaning of which is "white leaf"—is a kind of chicory, which forms a close head of leaves very similar in habit to that of the upright headed, or *Cos lettuces*. The common chicory is a well-known roadside weed in many parts of the country, notwithstanding the roots are largely imported as a beverage material to mix with coffee, or to be used as a substitute for that berry. The slender roots of the chicory are much employed in France for forcing into growth in dark apartments, during winter, the delicate blanched leaves being used as a salad under the name of *Barbe du Capucine*. These leaves are quite bitter, and not agreeable to every one. The witloof variety, also called the large-rooted Brussels chicory, has a thick, stubby root, also much used as a coffee mixture, and is said to be the most profitable variety that is cultivated for that purpose. In Brussels, the leafy heads of the witloof are cooked whole and eaten with cream sauce, and in this mode it is much esteemed as a vegetable dish for the dinner-table. It is equally as good as a winter salad, and is less bitter than the common chicory when used for this purpose.

To grow the witloof properly requires a rich and deeply-worked soil, in which the seeds are sown in spring, and deposited in drills, which are about 18 inches apart, and as the young plants progress they are thinned out, so as to be about 4 inches from each other. They will have completed their growth by the end of October; they are then lifted with care, so as not to cut or bruise the principal root, the leaves cut back to a length of about 2 inches from the crown of the root, and stored in a warm cellar in the dark. The roots are set upright, a few inches apart,

in light, rich soil of any kind, which may be secured by a liberal admixture of sand, leaf mold, or prepared compost, pressed firmly between the roots, and the tops will develop in time, according to the warmth of the room.

The temperature usually kept up in a greenhouse is well suited for its growth, and if planted in a dark inclosure, under the shelves or staging, a crop of leaves will be secured.

In Brussel, where the markets are supplied with this vegetable from Christmas till Easter, and later, the common practice is to store the roots thickly in beds, on a dry situation, in a field or garden. These beds are formed by digging out a shallow trench, from 8 to 12 inches below the surface, and 3 feet in width. In the bottom of this trench the roots are planted upright, or slightly inclined, at a distance of about 1 inch from one another, and in rows about 8 inches apart. Between the roots light soil or compost is placed and firmly pressed, so that no space may be left, and finally the surface is covered with 2 or 3 inches of the light soil, through which the young growths will push. The whole is then inclosed with a rude lattice frame, the top of which is elevated a foot above the plants; this prevents the covering material from pressing them. Fresh stable manure, to the thickness of 3 or 4 feet, is now put over the frame, completely inclosing the plants, the heat generated by the fermenting of the manure being sufficient to start the plants into growth; the progress of the inclosed vegetation being watched from time to time, the proper period for cutting the crop is readily ascertained.

SESAMUM INDICUM.

Among oil-yielding plants the sesame plant is frequently referred to. Some correspondents allude to it as furnishing ben-oil, or the oil of ben. This mistake no doubt originates from the common name of the leaves of the *Sesamum*, which are sometimes called benne leaves. The true oil of ben is prepared from the seeds of *Moringa pterygosperma*, which are called ben-nuts, and yield a peculiar kind of fluid oil, in the East Indies. This oil is reputed for its value for watches, and is more of a novelty than it is an article of commerce anywhere; on the contrary, the *Sesamum* is one of the valuable oil-yielding plants of the world.

The sesame is an annual herb, a native of the East Indies, but widely cultivated in tropical and semi-tropical climates throughout the world, for the sake of the oil contained in its seeds and other uses to which the latter are applied.

There are two varieties in cultivation, the white-seeded and the black-seeded; the black-seeded is said to be the best oil-producing variety, although the difference between the two kinds is not considered to be of any great moment.

Its cultivation is of the most simple kind. It is sown thinly in drills, after the soil becomes warm in spring, and the stems are collected and dried when the seed is ripe. The seeds are thrashed out in the ordinary manner adopted for rape-seed and similar products.

The oil is known as gingelly or sesame oil. The best quality is obtained by first washing the black seeds in cold water, or boiling them for a short time until the reddish coloring matter of the skin is removed and the seeds have become white. They are then dried in the sun, after which the oil is expressed. The seeds contain about 40 per cent. of oil.

Sesamum-oil is insoluble in alcohol, readily saponifies with alkalies, and combines with the oxide of lead. For all purposes of medicine and

pharmacy it is considered equal to the best olive-oil. It will keep for many years without becoming rancid either in smell or taste, and is said to be largely used in increasing the amount of the olive-oil of commerce. In Japan it is used for cookery purposes, and is preferred to all others as a salad-oil. It is sufficiently free from smell to admit of being made the medium of extracting the perfume of the jasmine, tuberose, the orange, and other fragrant flowers for purposes of perfumery. It is used medicinally as a laxative, and is preferred by some to castor-oil.

The cake, after expression, mixed with honey and preserved citron, is esteemed an Oriental luxury, and the roasted seeds are used as a substitute for coffee. The cake, after pressure, is also employed as a food for bees. The plant has long been cultivated to some extent in the Southern States, yielding an abundance of oil of the best quality; and it could be produced in any quantities that commerce might demand or farming profits justify.

The leaves of the *Sesamum*, under the name of benne leaves, are valued for their mucilaginous properties; two or three of the fresh leaves are soaked in a tumbler of water. Administered repeatedly, this gummy water is a popular domestic prescription for some complaints in children.

ARACHIS HYPOGÆA.

The ground-nut, or pea-nut, may also be mentioned in connection with oil-bearing plants. The seeds are among the best known as oil-producers, yielding from 40 to 45 per cent. of oil, which is not inferior to that obtained from the olive as regards quality, and is good for every purpose for which olive-oil is used. It is a good lamp-oil, burning with little smoke, a clear flame, and affords a very full, bright light. It is one of the best lubricating oils for machinery; and for all alimentary purposes it is equal to the best olive-oil, and it is said to be largely substituted for that article in commerce. Many thousands of tons of the nuts are annually imported into France for the purpose of expressing the oil, which, it is stated, finds its way into the trade under the name of olive-oil, which can scarcely be called an adulteration, as the pea-nut-oil possesses a sweetness and delicacy not easily surpassed. The ground-nut is grown in immense quantities in the East India Islands and along the African coast, mainly for the sake of its oil. In Java and Malacca it is known as katjang-oil. Another use made of the nuts (which is said to be increasing) is that of grinding them up for mixing with cacao in the preparation of chocolate, and it is freely asserted that in the manufacture of the latter, where the ground-nut is easily procured, the cacoa is entirely omitted in the preparation of so-called chocolate condiments.

MADIA SATIVA.

This plant is found in California, Oregon, and other parts of the States bordering on the Pacific, where it sometimes is called tar-weed. In Chili, where it is also a native, it is cultivated for the sake of the oil which is expressed from the seeds. This oil is used as a salad-oil, and, indeed, for all purposes to which olive-oil is applicable. It has been introduced and cultivated both in European and Asiatic countries as an oil-producing plant, and it is stated that the produce per acre is about the same as that yielded by rape and poppy seeds.

To those who are interested in oil-producing plants, the following table, quoted from Boussingault, shows the results of some experiments made

by M. Gauzac, of Dagny. All of the plants mentioned can be matured in any climate where Indian corn will ripen.

Names of plants.	Seeds produced per acre.			Oil obtained per acre.		Oil.	Cake.
	Cwt.	*qrs.*	*lbs.*	*Lbs.*	*ozs.*	*Per cent.*	*Per cent.*
Colewort	19	0	15	875	4	40	54
Rocket	15	1	3	320	8	18	73
Winter rape	16	2	18	641	6	33	62
Swedish turnips	15	1	25	595	8	33	62
Curled colewort	16	2	18	641	6	33	62
Turnip-cabbage	13	3	19	565	4	33	61
Gold of pleasure	17	1	16	545	8	27	72
Sunflower	15	3	14	275	0	15	80
Flax	15	1	25	385	0	22	69
White poppy	10	1	18	560	8	46	52
Hemp	7	3	21	229	0	25	70
Summer rape	11	3	17	412	5	30	65

JUTE.

The following remarks on jute and the plants which produce it have been prepared in accordance with inquiries on these subjects:

The plants furnishing jute have been cultivated by the natives of India for their own manufactures for many centuries. The word "jute" was originally used as a synonym for fiber, and is supposed to be the anglicized form of the Indian word *jhot*, which was formerly applied to vegetable fibers generally regardless of their origin; but the jute of commerce, at the present time, is yielded by two distinct species of plants belonging to the natural order *Tilliaceæ*, the *Corchorus olitorius*, and *Corchorus capsularis.*

These two species are similar in general appearance, shape of leaves, color of flowers, and habits of growth, differing only in the formation of their seed-pods; those of the *C. capsularis* being short, globular, and wrinkled, while those of *C. olitorius* are about the thickness of a quill, and about two inches in length. Both plants are annual, and grow from 6 to 16 feet or more in height, average of crops being about 10 feet high, with stems from one-half inch to one and one-half inches in thickness, seldom sending out side branches except near the top.

Each of these species has a white and a reddish variety; the stalks and leaves of the first-named being of a light green color, whereas in the second-named variety the stalks are red and the leaves red-veined.

The leaves of both these species are used as pot-herbs and as an ingredient in soups. *C. olitorius* is largely grown about Aleppo as a pot-herb, the Jews boiling the leaves to eat with their meat; hence the plant is oftentimes called Jews' mallow.

An infusion of the dried leaves is used as a tonic bitter; and medicinally they hold an important place in the East Indian native pharmacopœia.

The roots of the plants are used in the manufacture of paper; an oil for burning is extracted from the seed, but it yields so small a quantity of oil that the plants cannot be ranked among those profitable for their oil-bearing qualities, and the cake left after expression is not nutritious as food for live stock.

The *Corchorus capsularis* is the species principally cultivated in the central and eastern districts of Lower Bengal; but the *Corchorus olitorius* is more largely grown in the districts near Calcutta, and from its fiber is manufactured the well-known Luckhipore jute of Hooghly, which also goes by the name of *Desi* jute. There is no difference in the quality

of the fibers produced by these two species, but in commerce marked differences are noticed in the productions of different places; these differences are attributed to climate, soil, time of cutting and methods of preparation of the fiber.

The best variety is called *Uttariya*, which is said to possess to the greatest extent those properties which are essentially necessary in fiber intended for spinning, namely, length, color, and strength; this is understood to be produced by the white varieties of *Corchorus*. The next in quality is called *Deswal*, which is esteemed in commerce on account of its fineness, softness, bright color, and strength; this is said to be produced by *C. capsularis*. The *Desi* has a long fine, and soft fiber, and is mainly produced by *C. olitorius*. The *Deora* is much used for the manufacture of ropes; it is strong, coarse, and black; this derives its name from a locality.

The best *Uttariya* jute usually brings 75 per cent. more in market than other kinds. The time of cutting, preparation before steeping, the length of time it remains in water, and the quality of the water, all seem to affect in a greater or lesser degree the value of the fiber. The best time for cutting is when the plant is in flower, and just before the first formation of seed-pods. The fiber from this cutting is of superior quality and of a fine glossy appearance. If cut earlier than this the fiber is very beautiful but lacks strength; if cut after the plants have fruited or seeded, the fiber is strong but harsh, wanting in gloss, mixed with bark, and woody in its general character, although the quantity is greater than is procured from the earlier cuttings. The later cuttings invariably produce fiber of a dark or grayish color.

After cutting, the stalks are left to stand in the field for a couple of days to allow some of the juices to evaporate. When so treated the stalks rot more quickly, and the fiber is not injured, as too much steeping impairs its value; steeping in water for fifteen to twenty days will then prepare it for manufacture. Too much steeping, as also using dirty water, will make the fiber of a dirty, dark color.

How far the cultivation and preparation of this fiber for the manufacturer may be profitable remains to be seen. With such improved methods and processes of handling and preparing for market as experience will speedily mature, the grower will doubtless find it a profitable crop; but unless the machinery for manufacture be ample and of the most improved kinds, the profits of manufacture may not prove very attractive. The following remarks on the jute industry in Bengal as it was several years ago, are instructive in this connection:

The manufacture of gunny-bags employs all classes, and penetrates into every household. Men, women, and children find occupation therein. Boatmen in their spare moments, husbandmen, palankeen-carriers, and domestic servants, everybody, in fact, being Hindoos (for Mussulmen spin cotton only), pass their leisure moments, distaff in hand, spinning gunny twist. Its preparation, together with the weaving into lengths, form the never-failing resource of that most humble, patient, and despised of created beings, the Hindoo widow; this manufacture spares her from being a charge on her family; she can always earn her bread. There is, perhaps, no other article so universally diffused over the globe as the Indian gunny-bag. All the finer and long-stapled jute is reserved for the export trade, the short staple serves for the local manufactures, and it may be remarked that a given weight of gunny-bags may be purchased at about the same price as a similar weight of raw material, leaving no apparent margin of profit for spinning and weaving. The gunny-bag or cloth is sent from Calcutta to Penang, Singapore, Batavia, and the whole of the Indian Archipelago, for packing pepper, coffee, sugar, &c.; to the west coast of America for nitrate of soda, borate of lime, regulus of silver, &c.; to the Brazils for coffee and cotton, and to the United States for packing cotton. Thus it finds its way to Liverpool, London, and other European ports, and is sold to the wholesale dealer with the sugar, coffee, pepper, and cotton. When again disposed to retail merchants in the country, the bags are

purchased for making mats, and these mats are widely sold and distributed all ove. the country. There are people who make a good trade even by buying up the bags that have held the sugar, and selling them again to the ginger-beer or "pop" manufacturers, who first boil them to get out all the saccharine matter to sweeten this popular beverage, and then dispose of the bags to the mat-makers.

Respectfully submitted.

WILLIAM SAUNDERS,
Superintendent of Gardens and Grounds.

To Hon. WM. G. LE DUC,
Commissioner of Agriculture.

REPORT OF THE CHEMIST.

SIR: The work of the Chemical Division of the department prosecuted during the past year consists of—

1. Analysis of lime marls.
2. Examination of soils.
3. Analysis of bat guano from near Galveston, Tex.
4. Analysis of sugar from the early amber sugar cane.
5. Estimations of sugar in various beets sent to the department.
6. Examination and report of an experiment in beet culture made on Batsto farm in Atlantic County, N. J.
7. Experiments to determine the presence or absence of the so-called peptone forming ferment in the roots of plants.
8. Investigation of American sumac, to determine—
   - A. At what time during the season the spontaneous growth of our country should be collected in order to secure the highest possible proportion of tannic acid in the product.
   - B. The causes producing the difference in the market values of the American and Sicilian products.
   - C. A practical method for obviating these causes.
9. Investigation of the physical and chemical causes tending to the production of mildew and rot.

Besides the work here indicated, a large amount of unimportant qualitative work, requiring a great deal of time, has been attended to.

The work of analysis and of regular investigation has also been seriously interfered with by the requirements of correspondence and consultation.

1. The examination of marls has been confined to those having carbonate of lime as a basis, principally the shell-marls of the Tertiary formations.

As will be seen, the value of these marls depends entirely upon the carbonate of lime they contain, for they seldom if ever contain any appreciable quantity of other valuable constituents.

The percentages of phosphoric or potash seldom reach half of one per cent., and in the majority of cases only traces of them are found.

The shell-marls are valuable for direct application only when the shells, exposed to atmospheric influences, readily disintegrate and fall to powder, and the sedimentary lime marls, like those of Florida, are valuable only when the carbonate of lime is present in a finely-divided condition. In all cases in which they are at all rocky and fail to disintegrate when exposed, they should be burned previous to application. But that of Mr. Whitner, noticed below, would not be worth the trouble and expense involved.

The same is true of the shell marls. To be worth burning, they should contain at least 50 per cent. of shells of carbonate of lime, and even then it is questionable whether the work would prove profitable. Indeed, analysis of these Tertiary marls heretofore made in the department show their value to be very low, and the present analysis is seen to confirm the former conclusions with regard to them.

The following table indicates the results of the analysis made:

	I.	II.	III.	IV.
Lime	10.8866	12.9155	11.924	10.831
Phosphoric acid	0.4822	Trace ..	0.421	....
Potash	Trace...	0.0381	....	....
Insoluble matter	32.93	53.3271	....	....
Undetermined	55.7021	33.7193	87.655	....

Samples Nos. I and II were presented for analysis by Mr. J. J. Shannon, Meridian, Miss.; No. III by W. R. Carter, Beebe, Ark. These were all shell-marls. No. IV was sent by Mr. B. F. Whitner, Fort Reed, Fla. The soil examined was also sent by Mr. Whitner. He states that where this soil prevails orange trees die after two or three years, and it is consequently denominated "die-back" soil. Careful qualitative examination failed to reveal the presence of any poisonous quality. It is impossible, without a thorough examination of the character of the subsoil and the surroundings, to positively assign any reason for this influence upon the orange trees, but it is probable that judicious applications of lime, the phosphates, and potash salts will be effective in removing the troublesome cause. The sample of soil presented was sand, and contained a small proportion of organic matter.

3. The statements made in the last annual report concerning the value of the bat guanos of the South have received further confirmation in the results of an analysis of a sample received from Mr. A. H. Kent, of Galveston, Tex.

These deposits are probably far more numerous than may be expected from the reports received at the department, but the samples already analyzed represent a value aggregating nearly $20,000,000. The mechanical condition of the material is excellent for ready application, and it will be found exceedingly valuable as a fertilizer for corn or tobacco, or, indeed, for any crop whatever.

The composition of the sample from Galveston is indicated in the following statement of analysis:

Organic and volatile constituents		86.300
Water	2.106	
Ammonia (actual)	2.267	
Organic nitrogen (representing of ammonia NH_3, 5.045)	4.155	
Undetermined	77.772	
Ash constituents		13.700
Lime	3.806	
Potassa	1.692	
Soda	0.146	
Phosphoric acid (in form of $Fe_2O_3PO_5$, 0.362)	1.173	
Insoluble matter	0.912	
Undetermined	5.431	
	100.000	0100.00

According to the generally accepted commercial values of the various important constituents, the guano represented by the sample analyzed, if of quality uniform with it, would be worth about fifty dollars per ton

of two thousand pounds. We regret that no description of the locality or extent of the deposit was given in the letter accompanying the sample, for such a description would be not only of interest but of value also.

4. Some time ago a sample of sugar made from the Early Amber sugar-cane was submitted for analysis. It has been made by merely expressing the juice by crushing the cane between rollers, concentrating in open pans to a consistency fit for crystallization, and filtering through coarse gunny-bags. The sugar thus obtained has the percentage composition indicated below:

Cane-sugar	88.8934
Grape sugar (glucose)	5.6100
Water (expelled at 110° C.)	5.8250
	100.3284

This shows the importance of the further study of the sorghum as a source of cane-sugar. If a product as good as that analyzed can be obtained in the rude and comparatively imperfect method described, it is reasonable to suppose that with the application of the most approved methods the extraction of sugar from this source will be attended with profit.

5. The great value of the sugar industries, and the interest lately aroused, caused a number of beets to be sent to the department for examination. Some of these were the sugar-beets, while others were merely mangolds. Unfortunately none of the specimens sent were accompanied with any information concerning the methods of cultivation or the fertilizers used, if any were employed. All were analyzed, however, and the results of some of the analyses show the capability of our cultivators to raise good beets for sugar manufacture; and if the present interest in the matter can be maintained, there appears to be no reason for failure to establish the industry in the Eastern States as successfully as it has already been established in California.* To attain this success, however, great attention must be paid to preparation of the soil, the character and composition of the fertilizers used, and the methods of cultivation adopted. These are facts that cannot be too frequently repeated.

The following table shows the results obtained by the analysis:

Origin.	Variety.	Date received.	Number of roots tested.	Mean weight of root.	Percentage— Of root available.	Of juice in root.	Of sugar in juice.	Of impurities in juice.
T. J. Beans, Morristown, N. J.	....	Oct. 31	3	1,018 grams / 3.34 lbs	76.55	69.02	7.75	1.875
B. W. Payne, Corning, N. Y.*	Imperial	Dec. 1	1	1,508 grams / 3.316 lbs	84.15	60.77	9.38	1.68
Do.†	White Sicilian	Dec. 1	2	830 grams / 1.82 lbs	......	60.15	10.18	1.75
J. J. Toon, Smyrna, Ga.	Mangold-wurzel	....	½	....	......	81.24	2.11	6.76
W. D. Lane, Middlebury, Vt.	Lane beet	....	..	977 grams / 2.149 lbs	74.0	51.12	4.72	3.66
Do	Red beet	....	..	1,357 grams / 2.985 lbs	88.58	58.05	6.10	3.40

*No. I. †No. II; raised at Elmira, New York.

*From information later received, it appears that the industry was a complete failure last year on account of the continued dry weather.

The beets sent by Mr. Thomas J. Beans and Mr. D. W. Payne represent crops that can undoubtedly be worked up for sugar with profit, and it is satisfactory to know that both these gentlemen are making active preparations for the cultivation of larger crops during the coming year.

6. But the most important and most satisfactory experiment in beet culture that has come under the notice of the Chemical Division, is that made at Batsto farm, in Atlantic County, New Jersey, by Mr. Joseph Wharton, of Camden, N. J. Mr. Wharton has purchased a large tract of land there, and last spring decided to devote a small portion of it to the experiment of raising beets and extracting the sugar from them on the farm. It was not his purpose, as will appear below, to produce crystallized sugar directly, but to concentrate the juice to sirup and send it in this form to the rectifiers for purification and crystallization.

In response to an invitation from Mr. Wharton, and in compliance with your instructions, I proceeded to Batsto farm and "examined as thoroughly as possible into the soil, seed, culture, quality of the product, mode of harvesting, and cost of beets delivered at the mill; also the manner of extracting the juice, arrangement and cost of machinery for reducing the juice to sirup or sugar, and the quality of the product." From the fact that the records of the experiment were not closely kept, and from various other reasonable causes, the results of my inquiries were not altogether satisfactory. Mr. Wharton's letter, which will be found below, explains the objects he had in view in making the experiment. It shall be my purpose in the following page to describe the experiment, and suggest modifications that I consider would be of value in future work:

CAMDEN, N. J., *December* 4, 1877.

DEAR SIR: When inviting you and other gentlemen to visit Batsto, I was perfectly aware of the crudity of my operations there, yet thought it might instruct you and them to see this serious though imperfect attempt at sirup-making from beets. I consider the result attained is so far valuable that it demonstrates the possibility of raising upon Jersey lands beets with a fair percentage of sugar, and further, the possibility of putting that sugar into salable condition as crude sirup by means of quite simple apparatus capable of being operated by intelligent farm-hands. No doubt a great obstacle in the minds of American farmers to the raising of sugar-beets has been the belief that a large and complicated establishment for the working up of the beets was indispensable to successful beet culture. My experiment has, I think, proved that beet juice, defecated with lime and heat and boiled down in an open pan, is fit for delivery to refiners, and is consequently salable. Probably neither the outlay for establishment nor the skill required would greatly, if at all, exceed that needed for a cheese factory. Quite possibly the joint efforts of a farming neighborhood may hereafter, in many places, establish beet-sirup houses as they have already established cheese factories. Of course the primary results of this first experiment of mine are very bad indeed; until great advances have been made and much larger crops are to be handled, loss must result.

Yours, truly,

JOSEPH WHARTON.

Hon. WM. G. LE DUC,
Commissioner of Agriculture.

The soil on which the crop was grown is merely loose, siliceous sand, with no apparent fertility, the surface soil containing a small quantity of organic matter, and in some cases a slight admixture of gravel. It is 8 inches deep, and is underlaid by a subsoil of yellow, ferruginous sand. It is sufficiently loose and pliable to need no pulverization, and the only preparation it received was a single plowing in April. It was then, without either harrowing or rolling, marked out in ridges, by making a furrow which was filled with manure and covered by throwing two furrows together over it. In the application of the manures, the lot on which those first planted were grown, and consisting of ten acres,

was divided, longitudinally, into five sections, which were fertilized after the manner and with the quantities indicated in the following diagram:

5	300 fish	lbs. guano,	an	1 d m	0 tons uck.			
4		kai	500 nit	lbs. alo	ne.			
3	300 fish	lbs. guano.	10 m	tons uck.	500 kai	lbs. nit.		Portion of field planted with seed from Antwerp. Barn-yard manure, and muck.
2	300 fish	lbs. guano,		10 tons muck.				
1	300 fish	lbs. guano.	8 t ma	ons rl.	4 or stable	5 tons manure		
	April 26	30	May 4	7	9	11	14	18 19 21 22

NOTE.—The remainder of the field was planted late in May, with seed obtained from abroad, but no attention was given to it, from the fact that the planting was too late, and the crop on that part failed completely. The seeds planted previous and up to May 14 were Vilmorins' White Silesian, bought from several dealers in Philadelphia. Those planted later were also White Silesian, imported from Antwerp. They were all soaked in cold water overnight, and then sown in rows about 2½ feet apart, crossing the field laterally. They were sown at different dates, as indicated in the lower row of the diagram. At first it was determined to plant about 4 pounds of seed per are, but this amount was subsequently increased to 10 pounds per acre. They were put into the ground to a depth of 1½ to 2 inches, by means of a hand-drill, which failed to deliver regularly, making a necessity for a great deal of subsequent transplanting, which, as is well known among beet-growers, is unsatisfactory, and is very unfavorable to the production of good beets. As a consequence, in this case there were very many bare spots in the field.

The cultivation of the crop on the light sandy soil of Batsto farm was not very difficult, and was effected by five applications during the season of the cultivator, followed by hoeing and hand-weeding. This process was rendered more troublesome and costly by the fact that during the five previous years the land had not been under any cultivation; was not in grass, and was, as a consequence, covered with weeds. The work of cultivating future crops will, therefore, be less costly. The crop was harvested about the 1st of November, no mechanical appliance being used, or indeed being necessary, for raising them, on account of the very loose and mellow condition of the soil. They were, therefore, pulled by hand, and stored for the short time required for this crop by piling them in heaps, with the roots toward the center, in such a manner that they would be covered by leaves, and thus protected from the influence of desiccation and frost. The quantity placed in each heap was never allowed to exceed ten tons, including the leaves and tops, on account of the possibilities of fermentation and heating.

From these heaps the roots were carried to a convenient place near the mill, where the tops and leaves were removed by means of a knife sufficiently heavy to enable the boy using it to effect the removal at a single

blow. The dirt adhering to the roots was then carefully removed by means of a washing apparatus. The nature of the soil admits of a very complete cleansing of the roots by very simple means, since the light sand falls off readily in water without any such scouring as would be needed to remove a sticky loam, and the apparatus employed therefore merely consists of a cylinder, 4½ feet long and 2 feet in diameter, hung upon an axis, to an extension of one end of which a crank is attached, enabling the workman in charge to turn it.

The cylinder is made up of wooden strips 1 inch square, attached longitudinally, with sufficient space between them to admit of a free play of water, and is placed in a cistern provided with a constant water-supply and overflow. The beets are passed in at one end, and, after a few revolutions of the cylinder, are taken out at the other end. To facilitate their removal, a triangular platform or partition is arranged at the end nearest the workman, that takes up a few beets with each revolution, which may then be taken off by hand. The beets, after having been thoroughly washed in this apparatus, are passed to the mill, which has been arranged in a building formerly used for a flouring-mill, and which was devoted temporarily to the experiment of the manufacture of beet-sugar. It contains three floors, upon which the apparatus was arranged in the manner indicated below. The washed beets as delivered to the mill are first reduced to pulp by means of a very efficient rasp, which is one of the best made abroad. It is provided at the top with a hopper, to the bottom of which are two plungers that work to and fro horizontally by a motion communicated by eccentric cog-wheels. These plungers force the beets that are fed to the machine against the cutting cylinder, which is furnished with saw-teeth. It revolves at the rate of about 800 times per minute, and is capable of reducing to pomace about 100 tons of beets per day. The pulp from the rasp is almost immediately passed to a press, consisting of a centrifugal filter, capable of receiving a charge of 150 pounds, and of revolving when in action at the rate of 900 times per minute. The action of the filter upon the pulp is continued about fifteen minutes, until most of the juice has been removed, when the pulp is washed with water, in quantity amounting to about 37 per cent. of the volume of the juice. By this means about 60 per cent. of juice is extracted, leaving 40 per cent. of the original weight of the pomace in the condition of a moderately dry pulp, fit for feeding the cattle.

After every fifth charge of the centrifugal machine, or at intervals of about two and one-half hours, the collected juice and washings, which generally amount to about 85 gallons or 700 pounds, are pumped to the upper floor of the building, where it is placed in the defecating-tubs and heated by means of a coil of steam-pipes to 90° or 95° C. (195° or 200° F.). When this temperature is reached, about six pounds of lime are added, and the temperature raised to about the boiling point, which is maintained until perfect defecation is accomplished.

The juice is then drawn off and passed through bag-filters, to separate the impurities and much of the scum that may accompany it. The scum remaining after drawing off the defecated liquor is subsequently placed in bags and submitted to pressure in order to remove from it any adhering juice. It is then preserved to be employed as a fertilizer, for which purpose it is quite valuable on account of the considerable proportion of phosphoric acid, nitrogen, and salt it contains.

The filtered juice, which is of a clear amber color, is passed to the concentrators, which are cast-iron sugar-pans, holding 120 gallons each, and provided inside with coils of iron pipe of 2 inches diameter, through which steam of forty-five pounds pressure is passed. Sulphuric acid is added

to the juice in the concentrators until the lime, added in the defecating-tubs, and not entirely removed with the impurities, is completely neutralized.

The concentration is then continued until a density of 32° Baumé is attained. The resulting sirup is then filtered through bags and packed in hogsheads ready for sending to the molasses-refiners for the extraction of the sugar.

The value of the sirup is estimated at about 30 cents per gallon, and by polarization, it is found to contain from 46 to 52 per cent. of sugar.

The refuse, consisting of the tops, leaves, and pulp, is, after admixture with salt, buried in trenches and preserved for cattle-food, for which purpose it is exceedingly valuable, the tops and leaves being estimated at $3 and the pulp at $5 per ton.

With regard to the total cost of the machinery no exact data could be given, because the account had not yet been made up, but it is expected to aggregate about $2,000. The same difficulty exists with regard to labor, &c., and for cultivating and handling the crop. The work of extracting the sugar required, besides that of the superintendent, the services of five men and one boy during the day, and of four men during the night, at an average cost of $1 per day for each.

The following communication concerning the quantity and quality of the crop has been received from Mr. Wharton:

DEAR SIR: Mr. Humphrey, superintendent, now reports that the weight of topped and dressed beet-roots treated at Batsto was 30.7 tons, yielding 11.8 tons pulp, 10 tons leaves and tops. The roots so prepared contained—

	Per cent.
Sugar	7.9
Impurities	2.6
	10.5

Coefficient of value, 74.

The product was three parcels of sirup, about 150 gallons each, having the composition stated below. No. 1 was passed through bone-black before boiling down. Nos. 2 and 3 were not, but simply defecated and boiled.

	No. 1.	No. 2.	No. 3.
Sugar	48.9	45.9	47.9
Glucose	0.0	0.0	0.0
Ash	3.0	4.5	5.0
Organic impurities	8.4	4.6	13.1
Water	40.0	35.0	34.0
	100.9	100.0	100.0

Estimated value of sirup by molasses dealers is from 30 to 35 cents per gallon.

Yours, truly,

JOSEPH WHARTON.

Hon. WM. G. LE DUC,
Commissioner of Agriculture.

While at Batsto I secured samples of the beets, defecated juice, and sirup for estimation of their values, and have found them to contain respectively, of valuable constituents, the quantities indicated in the following tables:

A.—BEETS.

	Number of roots.	Mean weight of roots.	Percentage— Of root available.	Of juice in root.	Of sugar in juice.	Of impurity in juice.
		Lbs.				
Sample No. 1	6	1.135	79.40	65.14	10.63	1.46
Sample No. 2	7	1.208	83.72	65.79	8.67	2.425

B.—CLARIFIED JUICE AND SIRUPS.

	Percentage of sugar.	Percentage of impurities.
Clarified juice	4.44	1.686
Sirup concentrated without filtering through bone-black	51.48	13.675
Sirup concentrated after filtering through bone-black	49.28	16.093

The experiment was not a financial success, nor was it expected by its projector that it would be, as will appear from the appended note from Mr. Joseph Wharton,* the intelligent and energetic proprietor of the farm, but it proved that beets of fair quality could be raised on the soil of that section. The soil is, it is true, poor and thin, but if it contains but little that is of value for plant-food, it also contains little that may exert an injurious influence upon the quality of the beets grown, so that the latter may be better governed here by the application of fertilizers, and only those need be applied that will increase the sugar contents without increasing the size of the beet or the impurities in the juice. All these are important considerations in the profitable cultivation of this valuable crop. In the present experiment, the rules adopted by beet-growers abroad, and proven by careful experiments made both in this country and in Europe to be most favorable to the growth of a product of the best quality, were not strictly adhered to. For instance, we find that on part of the field barn-yard manure was applied immediately preceding the planting. According to the adopted rules, however, this should be applied to the previous crop, or should be applied in the fall and plowed in deep, and even then it should be thoroughly well rotted previous to application. Again, we notice generous applications of fish-guano. Both the materials mentioned are highly nitrogenous, a quality fully proven to have an injurious influence by increasing the size of the beet and the impurities. It is but fair, however, to remark that Mr. Wharton, who is well aware of these facts, did not decide until last spring to plant beets, and he was therefore limited to spring-manuring with such fertilizers as were obtainable upon a farm which had long been utterly neglected, or nearly so. We notice the application of kainit or crude chloride of potassium.

*As to the question of profit and loss, the balance on the side of loss is so great as to seem quite absurd, and I have no hope of any sign of profit appearing until after years of patient toil and careful endeavor, if at all. There lies just the question I should like to solve, viz: whether, supposing all necessary skill, diligence, and capital to be applied, profit can at last be attained.

Yours, truly,

JOSEPH WHARTON.

There is no objection to the use of potash-salts, but Prof. Charles A. Goessman has established the fact that sulphate of potassium is the better potash compound to apply for the production of high sugar percentages. We find in our diagram indications of the application of no phosphates other than those contained in the marl and the fish-guano, yet we know that they have an exceedingly favorable influence, and often to such an extent that many foreign beet-growers use them (upon soils much richer, of course, than that of South Jersey) to the exclusion of all other fertilizers, the potash-salts included. Lime, if composted with the muck that can be obtained without difficulty in that region, would have a beneficial effect. Indeed, it might be used, in this connection, by following Prof. George H. Cook's suggestion with relation to its admixture with the greensand marls, with a view to the liberation of the potash they contain. The marl and lime could be mixed, and in order to facilitate the oxidation of the iron compounds of the marl, a small quantity of niter or salt could be added. After weathering, the whole might be composted with the muck, thus forming a good fertilizer of home production, which, together with some commercial phosphates, would furnish all that the crop would require.* We noticed, while at Batsto, the field prepared for a crop for next year. It had had no application of barn-yard or other manure, because there was none made upon the place and none could be bought in the neighborhood, and for this I would suggest the lime, marl, and muck compost, with an application of phosphate of lime in the spring. Marl thus treated would furnish potash sufficient, in connection with the lime, to satisfy the demands of the crop. A small quantity of sulphate of potassium might be applied with the phosphate, and by following such a course I firmly believe that a crop could be secured that would contain, instead of 8 to 10 per cent. of sugar, 12 or 14 per cent., and this, too, with a decreased percentage of impurities.

The climate of that section is good,† and the physical condition of the soil is good, so that the matter of raising good beets will depend upon the fertilizers, and if the acknowledged rules relating to this part of the business are followed, there is good reason to hope that the crops may be good also.

With regard to the method of extracting the juice, it appeared to me while there that it would have been better to combine, to a certain extent, the diffusion process with the use of the press, in order to secure economy of time in working and fuel in evaporating. Thus, if, instead of using for washing the pulp a volume of water equal to 37 per cent. of that of the juice, the pulp, before pressing, were mixed with about 15 per cent. of water, as recommended by Roberts, and, after two or three hours' standing, pressed out in the filter, and the pulp washed with about 5 per cent. volume of water, we would have a saving of at least 15 per cent. volume of water for subsequent evaporation. But this would necessarily be a matter for experiment, and, as suggested by Mr. Humphrey, might not effect sufficient saving to compensate for the increased space and apparatus that would be required. This is, however, one of the many minor points that must be determined by ex-

* The usual method of applying marl in the belt of farming region lying to the northwest of the sand district in which Batsto lies, is to mix marl with lime in this manner. About 15 to 20 per cent. of lime is considered sufficient. It is mixed while slaking with the marl, very much as a bed of mortar is made. This is the method I expect to follow.—W.

† The climate this year was very favorable in respect to rain-fall. It remains to be proven by experience of successive years whether the climate can be relied upon as habitually favorable to beets.—W.

perience, and Mr. Wharton says he is by no means sure that the centrifugal process will not be entirely thrown aside as soon as greater success in cultivation produces a crop large enough to warrant apparatus on a large scale.

INVESTIGATION TO DETERMINE THE PRESENCE OR ABSENCE OF THE SO-CALLED PEPTONE-FORMING FERMENT IN ROOTS.

The power of roots to act upon and render soluble the most refractory compounds in the soil, and the manner in which they absorb the nutritious materials which go to sustain the plant and provide the nourishment for its growth, in fact the function of the root in general has been written about, variously commented upon, and very carefully studied. Many investigators disbelieve in their power to render soluble any matters in the soil, and scout the idea of their having affinity for substances not readily soluble in water and the juices of the roots, and which are not capable of passing through the enveloping membranes by osmose and thus into the cell fluids, and in a similar manner throughout the entire plant. This class of thinkers and writers believe that all plant-food, in order to be available, must be in the form of inorganic compounds. Thus phosphoric acid can pass into the plant only as a soluble alkaline or earthy phosphate, nitrogen as ammonia or nitric acid, and carbon as carbonic acid. Later developments have, however, turned thoughts on the subject into another channel, and one which showed the possibility for many modifications of the accepted notions with relation to the function of the roots and their power over the elements of plant-food, whether inorganic or organic. I refer to the results of the able and interesting researches of Darwin and Hooker into the habits and actions of the insectivorous plants, and their power when having seized upon any body of a nitrogenous character, particularly albuminoids, to secrete the acid fluid capable of dissolving and placing at the disposal of the leaf on which it may have lodged for its own nourishment, and consequently that of the plant, the particle of food by a generous Providence or favorable breeze brought in its way. I refer also in this connection to the valuable investigations of Gorup-Besanez, who has carefully separated from this secreted fluid the active principle which constitutes the potency of this simple secretion, and also the success this investigator has been blessed with in his endeavor to separate the same principles from other plants and parts of plants, discovering its presence in seeds of vetch, hemp, and linseed, in germinated barley, and in kiln and air dried malt. If it exists in the seeds previous to germination and is found there after germination has taken place, its only function can have been that of rendering soluble and placing at the disposal of the youthful germ the nitrogenous substances of an organic character locked up in the insoluble compounds.

The careful observations of Darwin prove the capability of the plants to take within themselves and appropriate to themselves the matter made soluble by the secretions; and this is what takes place in the young plant evolving from the seed.

The principle referred to lay dormant during that condition in which freedom from acid reaction existed, but asserted its power when its potentiality was rendered active by the acid which always forms in the physical and chemical changes which the embryo must undergo before germination can take place. The question then arises, if the aërial portion of plants may secrete these acid substances that may prepare nutritive material for the nourishment of the plant, why may not this property

also reside in the underground portions of the plant? If it exists in a dormant condition in the seed before germination, and becomes powerful in preparing the food for the young plant subsequent to germination, why should this same property not reside in the root after the nutritive material of the seed has been transferred to the plant and exhausted? The latter must depend for its existence upon the nourishment supplied through this underground organ, which has so many qualities and actions in common with the aërial portions, which have the power of reducing organic nitrogenous material to available plant-food without causing it to undergo veritable decomposition. Both are acid in their reaction; both are equally affected by heat and cold; both have the power to arrest and prevent putrefaction; and both are equally affected by substances poisonous to plants. Roots are known to have the power to remove from the water in which they grow the nitrogenous organic material existing therein as impurities, and this property has been considered due to the oxygen they exhale; but why is it not as reasonable to suppose that this purification is effected by the action of an acid secretion endowed with digestive power similar to or identical with that of the leaves of the insectivorous plants, which could prepare the impurities for direct absorption and assimilation? If roots are endowed with this power, then our notions of vegetable nutrition must surely be materially modified.

Instead of looking for complete decomposition of nitrogenous organic matters previous to absorption and assimilation, they may be rendered soluble by means of a secretion like that already described, and taken up directly in the same manner as the dissolved albuminoids are taken in by the leaves. For the purpose of determining whether or not this power is possessed by roots, and whether the peculiar ferment, as it is sometimes called, resides in them, experiments were instituted in this department and carried out in the manner and with the results detailed below.

In the first experiment wheat, barley, and oats were separately sown in boxes filled with sand containing considerable organic matter; but it was found exceedingly difficult, and, in fact, almost impossible, to separate the roots free from dirt without a great deal of manipulation—so much so, that the roots obtained were of little or no value for subsequent work. In order to avoid this difficulty a box was prepared provided with a frame fitting closely in the top; over this frame was stretched netting, which was then thoroughly saturated with wax or paraffine. The box was then filled with a growing solution, containing of nutritive constituents the following proportion:

The amount of solution employed (30.5 liters) contained—

Potassic nitrate	30.5 grains, or 1.00	per cent.
Sodic nitrate	30.5 grains, or 1.00	per cent.
Calcic sulphate	9.15 grains, or 0.03	per cent.
Magnesic sulphate	9.15 grains, or 0.03	per cent.
Sodium chloride	12.3 grains, or 0.04	per cent.
Ferric chloride *	0.2 grains, or 0.006	per cent.
Calcic phosphate*	5.00 grains, or 0.0163	per cent.

Upon the netting were sown barley seeds, and the whole was placed in a favorable condition for germination and growth. After the roots had attained considerable development and all the nutritive material of the seed had been exhausted, the frame bearing the netting was removed from the box and the suspended roots freed from any adhering nutritive solution by washing in pure water. Care was observed that they should suffer no injury or laceration. They were then cut off close to the netting and placed in a mortar, some glycerine poured over them, and the whole triturated until the roots were finely divided; a small quantity of water was then added and the fluid separated by filtration through a linen bag.

*Rough approximation.

The solution thus obtained was then mixed with a considerable quantity of absolute alcohol and the resulting precipitate collected on a filter. After washing it was triturated in a mortar with glycerine, the soluble portion separated by filtration and treated with absolute alcohol as before. The product of this precipitation, after being collected, was then treated with water containing a small quantity of glycerine, and the solution thus obtained employed in the experiments with egg-albumen hardened by boiling, which were made as follows: To a small quantity of the solution a few drops of dilute hydrochloric acid and the pieces of hardened egg-albumen were added, and the whole allowed to stand in the warm part of the sand bath for 12 to 24 hours.

Hüffner's test was then applied, and in every case negative results were obtained.

The experiments were repeated three times with like results, proving the absence of the peptone-forming ferment in the roots. Repeated tests of like character made upon roots of the coffee-plant gave similar results.

Experiments to determine whether or not the roots themselves, by direct action, may have any dissolving influence upon hardened albumen have been projected, but must be left for the subject of future study; and there seem to be possibilities for interesting developments in connection with it.

AMERICAN SUMAC.

The rapidly increasing consumption of sumac by tanners of light leathers and by dyers causes a demand for this article which has, during the past few years, awakened a lively interest in the matter of the collection of the spontaneous growth of the same in this country, and in many instances has stimulated inquiries into the manner of its cultivation abroad and the more improved methods employed in its collection and preparation for the markets. In Virginia particularly, where the spontaneous growth of sumac is very abundant, it is estimated by Mr. Cornelius S. Ramsburg, of Georgetown, D. C., who has given a great deal of attention to the subject, that the amount collected this year will exceed 5,000 tons. It is difficult to obtain any reliable figures for the entire country from the fact that none are recorded concerning this very important industry. In all probability, however, those given above are too low, since in 1872 the existence of large areas along the Missouri River, densely covered with a growth of sumac, were reported to this department, and in the same year 12,000 pounds of the ground product were shipped to New Brunswick, N. S., by way of New York, from that locality. What may have been the development of the industry there and elsewhere since that time we have been unable to determine. However, accepting Mr. Ramsburg's figures, this does not represent one-half the consumption, as may be seen from the following table showing the importations during the ten years from 1867 to 1876 inclusive:

Year ending—	Quantity in pounds.	Value.
June 30, 1867	13,790,990	$559,421
1868	11,842,451	468,362
1869		536,083
1870	9,634,367	418,919
1871	10,341,787	420,823
1872	10,028,912	383,570
1873	13,160,114	463,780
1874	16,718,678	511,941
1875	16,542,548	533,713
1876	17,642,960	624,169

We see, therefore, that the annual consumption of the foreign product approximates 8,000 tons. This does not take into account that brought in by smuggling and false entries, which is said to be very considerable. There is another important comparison to be made here, viz., the difference in the value of the foreign and that of the home product. The value of the importations for 1876 amounts to the sum of $624,169 gold, while the value of the American product will not exceed $420,000 currency. Later advices from a private source state that the importation of sumac for the present year amounts to 11,000 tons, or $1,100,000 gold, estimating the value of the product at $100 per ton. Yet it has been conclusively proven that the proportion of tannic acid in the latter exceeds that found in the former by 6 or 8 per cent. It has often been stated that this difference in favor of the American product is very much greater, but my own investigations have failed to confirm such statements, and I have been unable to find any reliable analyses that support them. Notwithstanding this higher percentage of tannic acid in the American product, we undertook this summer to determine at what time during the season it is at the maximum, in order, by giving instructions concerning the time for collection, based upon the results of such investigation, to bring about a possible improvement in the product. At the same time it was obvious to us that we must look to some other source for the main cause of the difference in the values of the American and Sicilian productions, and why the latter is so much preferred by tanners and dyers. Upon inquiry among the dealers and practical tanners, we find that by using sumac of Sicilian growth and manufacture it is possible to make the finer white leathers so much used for gloves and fancy shoes, while by the employment of the American product the leather resulting has a disagreeable yellow or dark color. Many attempts have been made by those interested in collecting and grinding, by careful attention to the methods employed, to improve the quality of the home product and save the extra $50 per ton which is the present difference between the prices of American and Sicilian sumac.

In many cases these attempts have been partially successful, but not entirely so, and, as will appear below, the difficulty in question cannot be altogether remedied in this way. Since the present analyses, and those published elsewhere, show a higher percentage of tannic acid in favor of the American product, it is evident that the difficulty must depend entirely upon a coloring matter, which, according to Loewe (Fresenius's *Zeitschrift für analytische Chemie*, 1873, pp. 127, 128), consists of quercitrine and quercitine, which exists in larger quantity in the American than in the Sicilian.* Endeavors were made to determine a ready and practical mode by which the separation of these coloring matters from the tannic acid in solution and their estimation might be effected, but from the fact that their deportment with reagents is so similar to that of tannic acid, and their solubility in water appears to be so much modified by the presence of tannic acid, our endeavors to this end were unsuccessful. But while there may be no practicable method which may

* In the progress of my work I succeeded in separating a brown crystallized substance in the following manner: An extract of 100 grains of Fredericksburg sumac, containing 23.71 per cent. of tannic acid, was treated with solution of plumbic acetate, and the resulting precipitate, after separation by filtration and washing, was rubbed up with alcohol, and finally placed in suspension in a large volume of alcohol, through which sulphureted hydrogen gas was subsequently passed, until complete decomposition of the lead compound was effected. After separating the sulphide of lead and slightly concentrating the alcoholic solution, the crystals formed.

The crop obtained was not sufficient for complete examination, and the substance must, therefore, be the subject of future investigation.

be applied to the separation of the coloring matter when in solution, we believe we have discovered how it may be entirely avoided. The manner in which this may be affected will appear later on.

In the mean time let us compare the percentages of tannic acid in the product as indicated by our estimations in specimens collected at stated intervals during the season. Through the courtesy of Mr. German Smith, of Winchester, Va., samples of sumac were collected in the months of June, July, and August respectively. Of these samples those collected in June and July were mixed varieties, and of the product collected in August we secured samples of the leaves of *Rhus glabra* and *Rhus copallina* separately. For comparison with the Virginia material, and for use in the latter portion of the work, we applied to Mr. William S. Soule, of Boston, Mass., for a sample of Sicilian sumac, and he very kindly and very promptly supplied it. In all of these samples the tannic acid was estimated by means of the method of Jean, published in the *Bulletin de la Société Chimique de Paris*, and mentioned in the annual report of the department for 1876. I may state here that I found it convenient to modify somewhat the method as laid down by Jean. For instance, a decided improvement was experienced by increasing the strength of the iodine solution from 4 grains iodine per liter to 8 grains per liter, and with the solution of this strength I obtained exceedingly satisfactory results.

For the analysis I took 5 grains of each sample, placed them respectively in a casserole, poured upon them about 150 cubic centimeters of distilled water, and heated to boiling about fifteen minutes. After partial cooling and settling, the solutions were poured through linen filters, and the residues treated in a similar manner with water until all tannic acid was extracted. After the last boiling the whole was placed upon one filter, and when the liquid had nearly all passed through, the portion remaining was forced through by pressure. The solutions were then made up to 500 cubic centimeters, and for each assay 10 cubic centimeters were taken. The results obtained are indicated in the following table:

Variety.	Time of collection.	Percentage of tannic acid.
Winchester mixed	June	22.75
Winchester mixed	July	27.38
Winchester *Rhus glabra*	August	23.56
Winchester *Rhus copallina*	August	16.99
Sicilian *Rhus coriaria*		24.27

It is evident, therefore, that in order to secure the maximum amount of tannic acid the sumac should be collected in July.

But, as before stated, the coloring matter of the leaves has an important influence upon the value of the product, and it appeared of value to determine when it was present in smaller quantity.

At first it seemed reasonable to suppose that leaves from the young growth of wood, in which the coloring matter is not yet formed as in the older wood, might be collected and found free from this troublesome substance, but examinations proved that this is not the case. I therefore determined to make some experiments upon the color of precipitates with gelatine, made by means of solutions of the material collected in the different months, having the same strength in tannic acid for each. For the purpose of experiment, the qualities indicated in the following table

were taken, and to each specimen was added about 150 cubic centimeters of distilled water, and boiled for fifteen minutes, filtered through linen, and pressed out without washing, replacing the water which had been removed by evaporation during the boiling, and otherwise making the volume of each solution up to 150 cubic centimeters.

Variety.	Collected in—	Amount, taken in grains.
Winchester mixed	June	4.4
Winchester mixed	July	3.65
Winchester *Rhus copallina*	August	5.8
Winchester *Rhus glabra*	August	4.25
Sicilian		4.1

The gelatine solution employed contained 5 grains in 150 cubic centimeters of water. In the experiments I took 50 cubic centimeters of each sumac solution, and added thereto 10 cubic centimeters of the solution of gelatine. The colors of the precipitates obtained were as follows:

Variety.	Collected.	Color of precipitates.
Winchester mixed	June	Nearly white.
Winchester mixed	July	Decidedly yellowish-white.
Winchester *Rhus copallina*	August	Dirty yellow.
Winchester *Rhus glabra*	August	Very dirty white.
Fredericksburg mixed		Dirty yellow.
Sicilian		White, slightly yellowish tinge.

In some of the tests, the precipitates obtained by means of the solution of the June collections of Winchester mixed sumacs were perfectly white and very much cleaner than any obtained with the Sicilian product. The difference in the color of the precipitates obtained from the solution of the June collection and that obtained from solutions of the samples of later collections, was sufficiently marked to prove that the great difficulty in the way of the universal employment of the American to the exclusion of the expensive Sicilian product *may be obviated by making our collections early in the season; that is, in the month of June.* The percentage of tannic acid is not, it is true, quite as high as obtains in July, but it compares favorably with the Sicilian product, which, be it remembered, communicates a slightly yellowish tinge to the gelatine precipitate. The amount of coloring-matter found in the July collection is sufficient to account for the difference of $50 per ton in the market values of the sumac of home and foreign growth, regardless of the proportion of tannic acid. We would therefore advise that, for the purpose of tanning white and delicately-colored leathers, the collection be made in June, while for tanning dark-colored leathers, and for dyeing and calico-printing in dark colors, where the slightly-yellow color will have no injurious effect, the collections be made in July. It appears that for all purposes the sumac collected after the 1st of August is inferior in quality. In view of the facts here presented, we cannot help urging upon manufacturers the importance of encouraging the home producttion—of insisting that the collections be made early in the season, in order thus to bring about such a change in this matter as to prevent the annual expenditure of over $600,000 in gold for the sumac of foreign growth. They may insist upon a classification, depending upon the time of collection and the behavior of aqueous solutions of the material with solutions of gelatine. They might also insist upon a guaranteed percentage of tannic acid. By encouragement of the home trade and home productions, there is no reason

why the enormous annual expenditure above referred to should not be saved to American producers.

If the classifications mentioned were required, those interested in the collection would take care to secure the best quality in the product, by the means here shown to be at their command, while merely an offer of an advanced price, which the consumers can readily afford, would doubtless be sufficient to bring this about, and at the same time induce others to engage in the enterprise of collection, so that in a short time the home supply would be not only ample to meet the home demand, but also to make a good surplus for export to foreign markets. And all this may be secured from a spontaneous growth upon lands that would otherwise be almost utterly worthless, and with no immediate demand for the cultivation of the shrub. The importance of the matter also warrants the encouragement on the part of our legislators in Congress by the increase of the rate of duty now imposed upon the importations of sumac. Such increase should not be made of immediate effect, but should be deferred until after the 1st of August of the coming year. No inconvenience would be then felt by consumers on account of deficient supply to meet the present demands and the advanced cost consequent thereupon, while the increased supply of the home product that must follow such encouragement would be sufficient to meet future demands. In connection with this subject, a synopsis of the method of grinding and separating the different grades of sumac, which is described in the annual report of the department for 1869, may be of some interest.

Through Mr. Cornelius S. Ramsburg we have secured specimens of the products from the different stages of the process employed, and have taken occasion to estimate their value with reference to the tannic acid they contain. The raw material, as brought to the mill (for complete description of mill, see annual report for 1869), is passed through the grinding apparatus, and from this, after grinding, is passed through a revolving screen, divided into two sections, the first of which is provided with a sieve with 36 meshes per square inch, while the second part has but 9 meshes per inch.

The products resulting are:

1. Ground sumac, grade No. 1.
2. Fine stems and unground particles of leaves.
3. Coarse stems.

The second product is again passed through the mill, and the useful product resulting is ground sumac, grade No. 2.

No use is made of the coarse stems, but it has been suggested that on account of the considerable proportion of yellow coloring-matter they contain, they be employed in the production of flavine. Whether they may be thus applied must be the subject of future experiments. Estimations of the tannic acid in these several products gave the following results:

	Per cent.
No. 1 sumac	26 to 28
Exhausted stems	6.14
No. 2 sumac	14.72

The quality of the No. 2 sumac is often improved, before sending it to the market, by admixture of that of grade No. 1 sufficient to increase the proportion of tannic acid in it to 18 or 20 per cent.

Mr. Ramsburg's kindness has also enabled me to make estimations of tannic acid in varieties of sumac which grow extensively in Virginia, other than those analyzed and mentioned in the previous tables, and he

has brought in specimens of *Rhus glabra* and *Rhus typhina*. In the following table we compare the percentage of tannic acid they contain with that found in the *R. glabra* and *R. copallina* of Winchester. They were all collected in August, and do not give a maximum yield, but the figures below will serve to a certain extent to compare them:

R. typhina, Georgetown, D. C	16.18
R. glabra, Georgetown, D. C	16.50
R. glabra, Winchester, Va	23.56
R. copallina, Winchester, Va	16.99

These estimations should be duplicated during the coming year, upon specimens collected at favorable seasons. It is probable that a comparison between the varieties might lead to some facts of great value to collectors and dealers.

ON THE CONDITIONS IN NATURE WHICH MAY INFLUENCE OR TEND TO THE PRODUCTION OF MILDEW AND ROT.

The subject of mildew and rot has been carefully studied by eminent men. Nearly all sides of it have been considered by one and another, many useful methods for its prevention and removal having been suggested. By some writers it is said to be produced by long-continued, warm, damp weather, or by sudden changes of temperature. Others attribute the cause to damp or dry weather, according to the variety of fungus which appears. It is a prevalent belief among very many students of fungalogy and vegetable physiology that a plant can be attacked by mildew only when in a debilitated condition; and starting out with this general proposition, it is my intention to cite some of the conditions in nature with which all are familiar, and which may have a tendency to affect the plant in such a manner as to render it susceptible to the attacks under consideration. To elaborate the proposition, we accept the theory that mildew, *i. e.*, fungous growths, can injuriously affect plants of the higher order on which they exist only when they are in a debilitated condition and there is an interruption of the process of elaboration of the plastic material, during which the plant, by its vital functions, is unable to resist the advance of the germinating fungous spores. The debilitated condition need not be sufficient of itself to affect the plant injuriously, and it may be capable of recovery from such condition, but during the continuance of the latter the mycelium of fungi may effect penetration to the cell tissues, and having done so, may, as many vegetable physiologists believe, of itself be able to keep up a debilitated condition in the immediately surrounding parts, which in a short time may extend throughout the entire plant, admitting the free advance of the fungous growth and ultimately producing the death of the plant. As above stated, sudden changes of temperature are named among the prime causes of this troublesome malady, and this brings us, first, to the consideration of the influence of temperature on vegetation. In his admirable work on botany, Sachs says:

> On this subject, the important fact must first be noted that the exercise of every function is restricted to certain definite limits of temperature within which alone it can take place; *i. e.*, all functions are brought into play only when the temperature of the plant or of the particular part of the plant rises to a certain height above the freezing point of the sap, and cease when a certain maximum of temperature is attained, which can apparently never be permanently higher than 50° C. (122° F.). Hence the life of the plant, *i. e.*, the course of its vital processes, appears to be confined in general within the limits zero (32° F.) and 50° C. (122° F.). It must, however, be noted that the same functions may have very different limits between 0° (32° F.) and 50° C. (122° F.) in different plants, as is also the case with different functions in the same plant.

Further on he says:

That growth, like other phenomena, is more active the higher the (constant) temperature above the inferior limit, but there is a certain temperature at which growth reaches its maximum activity, and above which any further rise of temperature causes a diminution of its rapidity.

We see, therefore, that the vital functions of the plant may be interrupted, or at least rendered less active, by extremes of temperature, which in case of some plants are not very wide; and for those most affected by mildew and rot during growth, probably, upon thorough examination, will be found to be between 10° C. (50° F.) and 45° C. (113 F.).

Again he says:

The injury resulting from too high or too low a temperature may, under certain circumstances, be indirect and slow in its manifestation. This will be the case when a particular function is too highly excited or too much depressed, and thus the harmonious co-operation of the various vital processes is disturbed. Thus, growth may be so excited by too high a temperature that assimilation, especially when the light is deficient, is not sufficient to supply the necessary formative material, and the transpiration of the leaves may, in addition, be so much increased that the activity of the roots is insufficient to replace the loss.

On the other hand, too low a ground temperature may so depress the activity of the roots that even small losses by transpiration from the leaves can no longer be replaced.

The matter of mineral nutrition is also an important factor to be considered in connection with this subject; for with a deficiency of mineral elements, such, for instance, as potassium and phosphoric acid, there must be diminished activity in the transformation of the plastic material in the plant into vegetable tissue.

The conditions which may produce the debilitation above referred to, and for which we desire to point out familiar causes, may be reduced to—

I. Variations of temperature.

II. Temporary or continued deficiency of mineral nutrition.

The first may consist of—

1. Cold or reduction of temperature.
   A. By radiation.
   B. By evaporation.
   a. From the surface of the leaves.
   b. From the soil.
2. Heat or increase of temperature.
   A. By direct radiation.

We have, then, first to consider cold produced by radiation. On this subject, Sachs says:

The radiation of heat is a very frequent and rapid cause of change of temperature in most parts of plants, the chief effect of these changes being to bring about differences between the temperature of the surrounding medium and that of the plant, especially when the parts of the plant are small of size but have large hairy surfaces, as is the case with many leaves and internodes. It must be noted in this connection that the radiating power is equal to its absorptive power, and that radiation depends not merely on the temperature, but also on the diathermacy of the surrounding medium.

This corresponds with the observations on the causes of the formation of dew, made first by Wells and after him by Melloni, Glaisher, Martins, and others. They found that on clear nights the temperature of the plant was reduced to a much greater extent than on cloudy or partially-cloudy nights; and the celebrated author above quoted says: "How greatly the temperature of parts of plants of considerable superficial extent may be depressed by radiation below that of the air, is shown by the fact that a thermometer placed on the grass exposed to radiation indicates on clear nights a temperature several degrees lower than one placed in the air." Just here a consideration of the possible and probable variations of temperature necessary to the formation of dew, which is the visible result of this radiation, will be of interest.

If we examine the tables showing the difference of the temperature of the air and the dew-point, we find that it varies widely with the relative proportion of moisture in the atmosphere.

Thus, when the relative humidity is 70 and the temperature of the air is 70°, the difference between the latter and the temperature necessary to the formation of dew has been found to be 10°. When the relative humidity is 50 and the temperature of the air 73°, the variation becomes 20°; while if at the same air temperature the relative humidity be 43, the variation will be 25°. With the relative proportions of moisture here given, and with higher temperatures, these variations become still wider. We see, therefore, that during the dry weather that often occurs during the summer months, vegetation suffers not only from deficient moisture to supply its demand, but also from very much wider variations of temperature due to radiation. Indeed, it is during the prolonged summer droughts that we generally notice the heaviest dews.

Now, let us see what will be the temperature to which the plant must be subjected in consequence of this reduction due to radiation. Wells found that a thermometer laid upon a grass-plot on a clear night sank sometimes 14° lower than a similar theremometer suspended in free air at a height of four feet above the grass; and the observations of Pouillet seem to show that the diminution of temperature attending the production of dew is at all times sensibly constant at about the figure determined by Wells.

Our summer-night temperature usually varies between 70° and 85° F. With the reduction which must take place when the relative humidity is 70, we will have temperatures ranging from 60° to 75°; with the relative humidity of 50 we will have temperatures of 50° to 65°, while with the relative humidity of 43, which could, of course, occur only during very dry weather, the temperature would fall to 45° to 60° F.

But these are considerably below the lower limits of temperature at which it has been found by careful observation the movements of protoplasm and the transformation of plastic material can take place, and which, for even such hardy plants as the *Phaseolus* (bean) and *Zea mais* (corn), is stated at about 61° F. The lower limit for the more tender plants is doubtless much higher than this, so that it is easy to see how they may suffer and become debilitated by the *cold* of summer nights.

But the germination of fungus spores and the growth of mycelium, may take place at a much lower temperature and during the temporary interruption of the transformation of plastic material, which must occur at the reduced temperatures mentioned. The mycelium of the germinating spore may effect penetration through the epidermis of the plant into the cellular tissue beneath, where it may feed upon the dormant protoplasm, which is already fitted for assimilation.

This result having been arrived at, the recovery of the plant from the abnormal condition produced by the reduced temperature, which would otherwise take place, will be prevented, leaving the plant in condition favorable to the rapid growth and spread of the fungus even to the death of the plant.

But while the discoveries of Wells and his colleagues showed under what conditions radiation of heat from the plant into space and the production of dew could take place, they also showed how it could be prevented, and in this they give us a remedy for one of the possible causes of mildew and rot. They found, what is familiar to all, that dew is not formed on cloudy nights nor in sheltered positions. Indeed, one of Wells's experiments to show that the radiation of heat took place, and that the formation of dew went hand in hand with it, was to arrange a

board or piece of pasteboard on props and note the temperature and the production of dew in the grass below it and on some cotton wool on the top of it. He found that beneath the cover no dew was produced, and there was at the same time no reduction of temperature.

An experiment showing the practicability of the application of this idea to the prevention of mildew in many cases was made several years ago near Baltimore by Mr. William Saunders, present superintendent of gardens and grounds of the Department of Agriculture. He placed over a row of grape-vines simply a cover of boards, and as a result he found that no mildew appeared upon these vines, while those of an adjacent row which remained uncovered were severely attacked by mildew, and were almost entirely destroyed.

An objection might be raised against this method of prevention on account of the undesirable shade it would probably produce during the day, but this difficulty might be obviated by the use of glass if it were considered necessary. This would admit the passage of light but not or radiant heat from any other than an incandescent source, such as the sun. In many vineyards, however, where the only support to the vines is a simple pole or post, this could be surrounded by a square or circular screen made of thin boards. As the method has been successfully tried, it might be applied in many other cases that I shall not here take occasion to mention.

We now come to the second cause of reduction of temperature, *i. e.*, *evaporation;* and under this head we shall first consider that which may take place from the surface of the leaf. We have seen how debilitation of the plant, due to an interruption of the vital processes by cold, may be produced, and I propose here merely to show how evaporation may bring about the necessary conditions, and that it is often and indeed almost invariably followed by the appearance of fungus growth. Quoting again from Sachs, we find that "in the aerial parts of plants transpiration is an energetic additional cause of loss of temperature, inasmuch as water in the act of evaporation withdraws from the plant the amount of heat necessary to its vaporization, and hence makes it colder." If water upon a leaf be allowed to evaporate slowly, no injury results; but, if a current of dry air of average temperature, or even warm air, be caused to pass over it, a reduction of temperature will take place often greater than will occur in the production of dew. Indeed, it is well known in the graperies connected with the department that the vines may be wet with the syringe two or three times a day with no injurious effect, but rather a beneficial one. The atmosphere may thus be kept exceedingly moist for weeks, and even months, and no mildew will appear; but if at any time one of the windows or ventilators be opened so that a current of dry air may pass over a portion of a vine, its course will invariably be marked by a copious formation of mildew. This shows, therefore, that plants which are the most subject to attacks of mildew should be protected as far as possible from currents of dry air.

In the Azores this fact is illustrated in the improvement in the yield of the orange-groves after the high walls were built around them to protect them from the heavy gales which formerly proved so destructive. While providing shelter for their trees from the heavy gales, the orange-growers were also protecting them from the lighter currents of air which, by increasing the evaporation of water from the leaves, tend to the production of cold, and consequently of mildew.

The remedy here suggested has more ready application than that mentioned under radiation, and might be used to advantage not only by grape-growers but also by fruit-growers in general. Indeed, I am told its practice is not new in England, for there the horticulturists build

covered glass houses in which they plant fruit trees and vines. They therefore serve as a protection to the more tender fruits, and also to the grapes in the grounds, and have been found to be exceedingly beneficial in their effects.

It is not necessary that our horticulturists should practice the expensive English method of using glass, nor that followed in the Azores of building high stone walls, but high fences of wood could be constructed that would serve the same purposes, and would, I think, be within the reach of most fruit-growers. This fence may be replaced, or rather rendered permanent, by means of hedges of the more dense evergreens.

The next important cause of cold in relation to plant-growth is evaporation of water from the soil, and of this merely a brief consideration is necessary, since the facts relating to it are so evident.

Water is often allowed to collect in the soil with no means of exit other than by evaporation, and this means the absorption of a definite quantity of heat. Thus, it has been determined by observations and experiments made in the domain of thermodynamics, that for the evaporation of 100 pounds of water the amount of heat required or absorbed is equal to that produced by the combustion of 6.35 pounds of anthracite coal or 6.29 pounds of bituminous coal. Now, taking three inches as the average monthly rain-fall during the summer months, the amount of water to be evaporated from one acre of soil with deficient under-drainage, not taking into account surface-drainage, will require as much heat as would be produced in the combustion of 50 tons of anthracite coal. If we take two inches as the average monthly rain-fall during the summer months, the loss of heat due to evaporation would be equal to that resulting from the combustion of about 35 tons of coal. These figures, as above remarked, do not recognize any drainage whatever, and the loss of heat due to the cause in question will, of course, diminish in proportion to the facilities for drainage. With these facts in view, it is obvious that in the search for causes of mildew this matter of water in the soil should be taken into acconnt, and it would seem useless to urge the importance of under-drainage. Many writers urge the injury resulting from excessive moisture, and refer fungus growth back to this as the main cause, but it does not seem to occur to them that plants may grow and mature in water containing all the elements of plant-food, and if the temperature of the water be maintained, fungus growth will not appear. The cause in such cases is therefore not the presence of the water, but the loss of heat due to the evaporation of water,* and this evaporation can, of course, be prevented by thorough drainage.

In the classification of causes of debilitation we find next, heat, or increase of temperature, and to some of our readers this may seem out of place, since all vegetation is so luxuriant during the heated summer term; but, as above shown, we find that the higher limit of temperature at which the vital functions of the plant may act is fixed at about 120° F., and this temperature is often exceeded in situations exposed to the direct rays of the sun.

If, in such situations, the amount of moisture supplied to the plant be not sufficient to satisfy the demands made by transpiration, thus keeping up the equilibrium of temperature by evaporation from the leaves, the temperature of the exposed parts of plants will exceed the limit favorable to the movements of the protoplasm, and they must necessarily suffer and pass into the conditions favorable to the attacks of mildew. The remedy

* I, of course, also recognize the fact that the excess of water existing in the soil on account of deficient under-drainage may act injuriously by preventing the circulation of atmospheric oxygen in the soil, for the oxidation of the organic matter necessary to plant-nutrition. It makes this a double cause of the debilitation in question.

in this case, as in the others cited, suggests itself, and will doubtless be found in judicious irrigation whenever it may be necessary. The methods to this end will, of course, vary with the plant under treatment.

Another but less frequent cause may possibly be found in the condensation of the heat rays of the summer sun by drops of water resting on the surface of the leaf. The drops under such circumstances being usually globular, the focus of the concentrated rays will be found at the surface of the leaf, and the temperature of the particular spot will consequently be increased beyond the higher limit for growth. The favorable condition exists for a short time, it is true, but probably long enough for the rapidly growing mycelium to effect an entrance to the cellular tissue, and secure a firm and fatal footing there.

This cause is more hypothetical than the others cited, but, like the others, might be the subject of some interesting experiments to corroborate it. Such experiments I have planned, but have as yet been unable to execute them for want of time. The only requirements are plants which are frequently subject to attacks of fungus growths, a good reflector, a strong incandescent source of radiant heat, and a good and rapid absorbent of radiant heat. These may be arranged in a convenient manner, so that the *plant* under experiment may be subjected for a given time to the influence in question, then allowed to assume normal conditions and the effect will be noted. For instance, the plant may be placed in front of the reflector, in the focus of which may be held a quantity of freezing mixture. The plant should be allowed to remain there until by radiation of its heat its temperature has been reduced to or below the dew-point, and after the production of dew upon it again allowed to remain under normal conditions. After a reasonable time the difference between the plant experimented upon, and one remaining, with that exception, under precisely similar conditions, should be noted. The production of mildew as a secondary result, or its non-appearance, would prove the truth or falsity of the theory hereinbefore advanced.

The truth of the theory of the next cause of debilitation of plants sufficient to admit of the successful growth of fungi upon them, has received partial confirmation, at least, under my own supervision in the experiments about to be described, relating to the influence of deficient nutrition upon mildew and rot. For this purpose I had large boxes prepared, six feet square and three feet deep, in the center of which was placed a smaller one three feet square, of the same depth, and having a bottom in common with the larger one. The entire bottom was provided with numerous holes to admit of the free passage of water. The whole arrangement was placed in a tray about three inches deep, and supported about one inch above the bottom thereof. The outer and larger box was filled with soil to prevent any outside influences of temperature, &c., while the inner box was filled with ordinary soil of the field; two of the inner boxes of this description were entirely filled with garden soil, and a third was half filled with garden soil; the remainder being pure river sand. The three boxes were conveniently placed that they might be covered with glass at a distance of five or six feet above them.

The original idea with regard to the special matter under investigation in these experiments was, that during the dry weather in summer plants must be supplied with the moisture necessary to their growth by water carried up from the subsoil by capillary attraction; that this water is charged with mineral matters, nearly all of which are suitable for plant-food. It also carries with it the decomposition products of the soil, and thus the roots are continually supplied with the mineral ingredients of food necessary to their healthy growth. But in case of heavy rains, if the conditions of drainage be good, and they must, of course, be so to

satisfy the demands of the conditions above, the flow of water in the soil must be reversed. The rain-water from the surface will, in its passage to the subsoil, take up and carry with it the soluble elements of plant-food. The plant, by the increased moisture, will be stimulated to increased growth, but from lack of the mineral matters which have been carried away by the reversed flow, a sluggishness in the transformation of the plastic material in the leaves must occur, and until the supply of mineral matter returns to assist in the processes of assimilation, &c., there must exist a condition favorable to the successful advances of the fungus growth described above, and the plant must necessarily suffer.

In the experiments under consideration the aim was to produce artificially the conditions here described. The boxes were covered, and there was no danger from loss of heat by radiation. They were placed in sheltered positions, and were not much subject to air currents. Solutions were prepared containing all the elements of plant-food, and the trays in which the boxes were standing filled therewith.* Seeds of wheat, oats, and pease were sown in the soil of the inner boxes, and no water supplied except to the trays. The moisture necessary to the growth was, therefore, obtained only from the bottom by means of capillary attraction. The plants grew well, and about the time the blossoms were falling from the pease, and the fruit was forming, the solution was drawn off from the trays and the plants watered heavily with rain-water for several days—*i. e.*, artificial rains were established equivalent to a rain-fall of three inches or more each day. This was continued for some time, and on account of the character of the soil employed the removal of the nutritive principles from the soil about the roots was rendered very difficult. The plants subjected to this treatment, which previous to it were entirely free from any appearance of mildew, became subsequent thereto covered with fungus growth. This was especially true of the pease.† Rust was also found abundantly on the wheat and oats.

* The nutritive solution employed had the following composition:

	Per cent.
Bone-meal (in form of bone-meal superphosphate)	.179
Actual percentage of the superphosphate	.239
Potassium nitrate	.045
Calcium sulphate	.155
Potassium sulphate	.041
Magnesium sulphate	.054
Iron chloride	trace.
Total numeral constituents, something more than	.668
Water, less than	99.332
	100.000

† *Application of artificial rain and appearance of mildew.*
[Each box received the same amount of rain at each application.]

Rain. When applied.	Rain. Amount applied.	Mildew appeared in—
	Inches.	
September 20	3	
21	3	
22	3	
23	3	
26	....	Box No. 1.
28	4	
29	5	
October 1	6	
2	6	
12	....	Box No. 2.
13	4	Box No. 3.

The treatment with rain-water had to be long continued on account of the richness of the soil, as above stated. Since the soil employed was rich the water applied through the trays should have been simply river water, which would correspond more nearly in composition with the underground waters upon which plants must depend for their moisture during extended dry seasons; this would obviate the excess of nutritive material that must be washed out to secure marked results.

These experiments, therefore, while they afford partial confirmation of the theory advanced, should be repeated under modified methods; thus, instead of using fertile soil, clean river sand with convenient admixture of pure clay, sufficient to provide the proper capillary power, should be employed as the basis of soil, as nutritive solutions, such as that employed in the present experiments, could then be applied through the medium of the trays and the perforated bottom of the box. After a given time the supply of material to the bottom would be stopped as before by drawing off the nutritive solution, and the artificial rain established.

There should be three sets of boxes. For one set the conditions established at the start should be maintained throughout the entire investigation. To the other two sets the artificial rain should be applied, and to one of these two, at the end of the rain, nutritive material in solution should be applied to the surface of the soil. It is easy to see that if a number of boxes were prepared and treated after the manner here indicated, and the results noted, sufficient facts ought to be obtained in a single season to determine the question of the influence of heavy rains in summer on the mineral nutrition of vegetation, and remotely upon the question of mildew and rot. If upon the plants in the boxes, allowed to remain under the same conditions, no mildew appears, while upon that heavily watered it does appear, as in the experiments made during the past summer, it surely establishes a cause; and if while it appears upon one of the boxes thoroughly watered, but without subsequent application of nutritive material, it is not found on the other box submitted to exactly the same treatment, but receiving after the artificial rain nutritive material in quantity sufficient to satisfy the temporary demands of the crop until the return of the former supply, we surely determine a remedy. These are ideas that may be experimented upon in a practical way by horticulturists, and especially those who are working upon sandy soils, where leaching can more readily take place. Just after a continued summer rain let some of the vines or trees be supplied with fertilizing material, while others are left subject to the usual conditions, and note the appearance of fungus growths. Such experiments may perhaps be of no avail, but the time and means thus expended, if lost, will be lost in a good cause.

That exhaustion of the soil has a strong influence upon this matter finds, I think, ample corroboration in the present condition of the vineyards of many of the islands of Lake Erie, where, I have been informed, grapes have been grown on the same soil for twenty-five years, successively, with the application of no fertilizer whatever. During the earlier part of this term mildew and rot was scarcely known, but during late years the crops have been almost total failures. I am unable to say how far this difficulty may be due to removal of the protection from winds, &c., by clearing off the forests, but the failure to apply fertilizers has certainly been of material assistance in the fatal work, and the grape-growers there will, if they desire to grow good crops, have to bear in mind and practically apply the facts, that the waste and exhaustion of the stock of phosphoric acid and potash soil must be supplied for the

healthy existence of the plant family as surely as the stock of bread and beef must be renewed for the support of the human family.

During the year a great many investigations have been suggested and a great deal of work required that it was impossible to perform. It has been the constant endeavor of the division to confine the work to such matters as have not merely a local but a national importance, and to such as might prove of general scientific interest. At the same time, the practical application of the results obtained has been kept in view, and whenever any methods to that end have been suggested by the results of the work, they have been commended to the attention of those interested in the matters under consideration. Particular attention has been given to work that might tend to the establishment of new industries and provide employment for laboring classes in need of new sources of labor and income.

In closing this report, I desire to express the earnest hope that the division may receive such encouragement and such advancement in the future as will extend the scope of its work and importance, and increase its power and influence for good to the agricultural classes, and the promotion of chemical science as applied to agricultural industries.

Respectfully submitted.

WM. McMURTRIE,
Chemist in Chief.

To Hon. Wm. G. Le Duc,
Commissioner of Agriculture.

REPORT OF THE ENTOMOLOGIST AND CURATOR OF THE MUSEUM.

Sir: I respectfully submit the following reports: first, upon the *Hymenoptera* (bees, wasps, &c.), with descriptions and figures of those species especially injurious to agriculture, or interesting from form, habits, &c., and the second upon the condition of the museum, with a systematic classification of objects and brief outline of recent noteworthy additions.

HYMENOPTERA.

This order comprises insects having four wings generally transparent, naked, and furnished with a few branching veins, which are not reticulated or netted like those of the *Neuroptera* or dragon-flies. The name *Hymenoptera* is derived from two Greek words signifying a membrane and wing, from the structure of their wings, the two forward or anterior pair of which are generally larger than the posterior pair.

This order includes saw-flies, ichneumon flies, ants, wasps, bees, &c., and appears to form a sort of connecting link between the *Mandibulata*, or insects possessing jaws, like the *Coleoptera* or beetles, &c., and the *Haustellata*, or insects furnished only with sucker or proboscis, like the two-winged flies and true plant-bugs. The upper jaws of the *Hymenoptera* are stout, horny, and formed for biting or rending, while the two lower jaws form a sort of tongue or sucker for sucking or lapping vegetable or animal substances. Many of the females of the *Hymenoptera* are furnished with a poisonous sting or prickle at the hinder end of their body, for offense or defense against their numerous enemies, while others

are provided with a piercer or ovipositor of some kind to bore into vegetable substances, to cut holes in leaves, &c., in which to deposit their eggs, like the saw-flies, or to pierce the bodies of other insects, where their maggot-like larvæ, when hatched from the eggs, live upon the juice of caterpillars and other insects, the bodies of which they inhabit and eventually destroy, thus proving exceedingly useful to the farmer.

Several of the insects of this order display great sagacity or instinct in the storing up of their food and the care of their young, as exemplified by the bee, &c., not leaving them like the eggs of most of the other insects to mere chance to be hatched or fed. Insects of this order may be divided into two general divisions, *Terebrantia* or borers, and *Aculeata* or stingers. Westwood in his classification commences with the *Terebrantia* and finishes with the *Aculeata*, whereas other later authors commence with the *Aculeata*. We shall, however, partly follow Westwood, as, although he is the older authority, he generally has been very correct in his classification and descriptions, and it matters very little in such a necessarily short treatise as this what classification may be adopted here, provided the principal beneficial and injurious *Hymenoptera* can be readily referred to in case of need. The first family of the *Aculeata* comprises the *Tenthredinidæ* or saw-flies, the larvæ of which live in wood, the leaves of trees, &c. *Cimbex ulmi* or *americana* (Fig. 1) is one of the largest of these insects, being nearly three-quarters of an inch in length and of a stout, thick form. The eggs are deposited on the elm, generally in June or July, where the larvæ feed upon the foliage, and when they are fully grown crawl down the trunk and form large, tough, parchment-like cocoons, in which they remain until spring or early summer, and after changing into the pupa state, they finally, in June or July, change into large thick-bodied flies of a violet or blue color, having generally three or four oval yellowish or orange spots on each side of their body. The antennæ and lower part of legs are clay colored, somewhat resembling the spots. The larva is of a whitish color and rolls itself in a spiral form when on a leaf, and not only feeds upon the elm, but also upon the foliage of birch, linden, and willow. *Abia cerasi* or the cherry slug, in the larva state, is said to feed on the leaves of the wild cherry. They are about 0.60 in length and the fly is black, with pale-yellow feet, and appears about March in the State of New York. The larvæ of *Abia caprifolia*, or saw-fly of the tartarean honeysuckle, hatch out very early in the season, and when at rest lie curled upon a leaf and eat the foliage; when disturbed they emit a drop of watery fluid from the sides of their bodies and are easily destroyed, as when touched they drop suddenly to the ground where they are readily crushed under foot; they change into pupæ in pale-yellowish silken cocoons later in the summer or fall. The insect is 0.36 in length and 0.70 in expanse of wings, and is of a black color with a faint greenish reflection and two whitish bands at the base of the metathora; the wings are banded. The rose-slug or saw-fly, *Selandria rosæ* (Fig. 2), is a very common little saw-fly, injurious to the foliage of the rose. The eggs are deposited in May or June, in incisions made by the ovipositor or saw of the female in the leaves, each incision containing one single egg; the larvæ hatch out in about ten days and feed upon the parenchyma or fleshy part of the leaf; they cast their skins several times, and the pupæ are formed in small oval cells in the earth an inch or more under the surface. The larvæ are not slimy, and are of a pale-green color, yellowish on the under side. The male fly is 0.15 in length, the female 0.20. They are of a deep shiny black color, and the thorax is not red like some of the kindred species; the hind legs are

black with whitish knees and the wings are smoky-transparent. There are two or more generations annually in Maryland.

Tobacco-water and soap-suds have been recommended to destroy the larvæ or "worms." Weak carbolic acid, whale-oil, soap-suds, or an infusion of quassia have also been reported as beneficial, but probably Paris green and flour, or white hellebore, applied either dry when the leaves are moist, or in a wet state, mixed with water, would effectually destroy the worms when feeding and not prove injurious.

Another somewhat similar insect is sometimes very injurious to the foliage of the grape-vine in early summer and autumn.

These insects are well known to grape-culturists as the grape-vine slug or saw-fly, *Selandria vitis* (Fig. 3). They feed in companies of several together, side by side, on or near the edges of the leaves; the larvæ are twenty-footed, of a greenish color above and yellowish beneath, and have several rows of black dots across each wing. The head and tail are black. The pupæ are formed in small oval cells in the ground. The perfect fly is shiny, black, with red shoulders; the fore legs and undersides of some are pale yellow; the female is about 0.25 in length, and the wings are semitransparent. Paris green ought never to be used to destroy these larvæ, as it is a very violent poison and might be dusted over the fruit. The root of white hellebore powdered, although somewhat poisonous if used in any great quantity, has yet proved very efficacious, and at the same time innocuous, when used for the currant worm, an insect of very similar habits; it is applied either as mixed with water or when in a dry state, dusted over the plants when moist with dew or rain. The fruit, however, should be well washed before using.

The other compounds of whale-oil, soap, tobacco-water, &c., are liable also to the objection of producing a disagreeable flavor to the fruit if applied incautiously. As these larvæ are in the habit of climbing together in rows upon single leaves, it would be very easy to pick off such infested leaves when the worms are very young and trample them under foot.

Air-slacked lime has also been used, but is not as efficacious as the powdered hellebore.

The larvæ of *Selandria rubi*, or the raspberry saw-fly, is a small twenty-two-footed, smooth green worm, which attacks leaves of the raspberry. It is said to be covered with prickles after the last molt. The same remedies as recommended for the other saw-flies may be applied to this insect if it should become numerous. *Allantus* is closely allied to *Selandria* in structure and habits. *Allantus busillaris* (Fig. 4) has been figured here to give some idea of the form of some of these insects. *A. mellosus* and *ruficollis* are very much smaller in size. The larvæ of *Allantus sambuci*, or the elder saw-fly (Fig. 5) feed upon elder and willow, and are also figured as found in Maryland. *Dolerus arvensis* is a somewhat similar saw-fly, of a blue-black color; the larvæ are found on the willow in April and May. Not possessing a specimen of this insect from which to make a drawing we are obliged to figure *Dolerus sericeus* (Fig. 6), which is a closely allied insect. *Emphytus maculatus* has nine-jointed antennæ. It does considerable injury to the cultivated strawberry-plants in the Western States. The female is said to deposit her eggs early in May in the stems of the plants; the larvæ, which are of a dirty-yellow or gray-green color, when at rest curl their bodies spirally, and when fully grown are about three-quarters of an inch in length.

They eat holes in the leaves and molt their skins four times, and the perfect flies appear the end of June or beginning of July. A second brood appears later in the season and remains in the earth until April. The fly is pitchy black, with two rows of dirty white spots on the

abdomen. As we have not found this insect in our collection, we have taken the liberty of figuring an allied but larger species, *Emphytus tarsatus* of Say (Fig. 7). *Nematus* has also nine jointed antennæ. The European currant or gooseberry fly or worm, *Nematus ventricosus*, is said to have been imported from Europe about the year 1860 and arrived in Massachusetts in 1865. At present it does much injury to currant-bushes by destroying the foliage. The eggs are deposited in regular rows along the under side of the leaves, on the middle and larger ribs. Their eggs hatch in about four days, and the larvæ, after destroying the foliage and when ready to change, burrow into the ground, where they spin small silken cocoons, in which they change into pupæ. The first brood of insects appear about July and lays the eggs for the second generation, which pass the winter in the earth as larvæ and pupæ, to reappear as perfect insects the following spring. Thus, there are two broods each season. The larvæ are pale-green, with head, tail, and feet black, and they have numerous black spots regularly arranged around the body. The female insect is of a bright honey-yellow color, with black head; the male has a black thorax. The early changes from the larva state must be extremely rapid, as it is said to feed, molt, and burrow in the ground, all within a period of eight days.

The usual remedy recommended for the destruction of this saw-fly is to strew slacked lime over the bushes (destroying both leaves and fruit), but Dr. Mach, of Salem, recommends a solution of a pound of copper to six gallons of water, sprinkled over the bushes; this blackens the leaves, but is said not to injure them permanently. Carbolate of lime sprinkled over the plants as soon as the worms make their appearance has also been recommended, but white hellebore-root, powdered, dusted over the leaves when moist with dew or rain, or used when mixed with water, and applied either through the rose of a watering-can, or with a garden-syringe, is said to have proved an effectual remedy, and if washed off afterward, before using the fruit, has hitherto proved to be perfectly harmless to mankind. *Nematus ventricosus* is said to be attacked by a parasite *Brachypterus* (*Cryptus*) *micropterus*, also a hymenopterus insect. The larvæ of *Nematus trilineatus* have been reported as destructive to the foliage of the weeping-willow, eating all the leaf except the inner mid-rib. These larvæ have twenty feet and are of a bright-green color, palest at the head and tail, with five rows of black dots down their back, and a larger row of black dots above the feet. They are generally found with their bodies bent up over their backs. The male insects are said to be black on the thorax. Not possessing a specimen of this species, we have figured *Nematus integer* (Fig. 8), an insect of the same family found in this neighborhood.

Pristiphora grossulariæ, or the native currant-worm or saw-fly or worm, differs from the imported species in many respects. The larva, which is 0.50 in length, is of an uniform green color, without the black dotting always found on the imported species, except after the last molt; it also spins its cocoon among twigs and leaves of the bushes on which it feeds, instead of going into the earth. The insects, which are black, appear about two weeks after the last molt; the larvæ are pale-green when young, with black head, but when mature the head becomes pale-yellow or greenish and has a lateral brownish stripe. The same remedies are recommended for this insect as have been mentioned for the foreign currant-worm. Another saw-fly, *Pristiphora identidem*, has been reported as very injurious to the foliage of the cranberry. The larvæ, when first hatched, are of a light or pale yellowish green color and grow darker by age; when fully grown they are 0.30 in length and have a lighter whitish-

green stripe running above from head to tail. The cocoon was spun in June, among the rubbish at the bottom of the breeding-box, and the insects appeared in June. The male is of a shiny-black color. The same remedies as recommended for the other saw-flies on currants, &c., will also apply to this insect. Walsh also speaks of another saw-fly, *Pristiphora sycophanta*, as a gnat gall-fly in the *Cecidomyia* (or gall-gnat *Diptera*), inhabiting the willow.

Lophyrus abietis (Fig. 9), or the saw-fly of the pine, has been reported as injurious to the foliage or needles of the pine. The larvæ are gregarious, many of them being found in company together feeding on the leaves of pitch-pine, fir, &c. The larvæ are 0.50 in length, and are of a pale, dirty-gray color, yellowish beneath when young, but become altogether more of a yellowish color when more mature.

The pupæ are formed in small, tough cocoons, spun among the leaves. The males have feathered antennæ, and are black above but brownish beneath; the females are yellowish-brown above, with a short, black stripe on each side of the thorax. Some of the flies appeared in August, but it was stated that probably the greater number remained unchanged until the following spring. Showering with a solution of carbolic acid, petroleum, whale-oil soap, tobacco-water, &c., has been recommended, and Paris green or hellebore would doubtless destroy multitudes should they become very numerous; the Paris green, however, might injure cattle, sheep, &c., if grazing near the trees, and when using any such deleterious substances workmen should always keep to windward so as not to inhale the poisonous dust. Other insects of the same family are reported as injuring the pitch-pine's foliage, such as *Lophyrus pinus-regedis* and others, while *Lophyrus lecontei* is said to prefer the Scotch and Austrian pines. These are all mentioned in Professor Packard's valuable work (Guide to the Study of Insects), a work which ought to be in every agricultural library. The Austrian pine is also reported to be injured by a species of *Lyda*, a kind of saw-fly, the larvæ of which form a silken web filled with castings, forming a mass about six inches in diameter among the leaves. These larvæ have no abdominal legs like the other saw-flies, and only six pectoral feet; they are likewise distinguished by two antennæ-like appendages to the head and two similar appendages to the hind part of the body. A similar insect found in the wild cherry, probably *Lyda serotina* (Fig. 10), a young specimen of which is figured here to show the peculiarity of the form of this worm, and the insect of *Lyda abdominalis* (Fig. 11) is figured to show the full-grown fly. A specimen of *Lyda* in Europe is destroyed by an hymenopterous insect, *Exetastes fulvipes* (Fig. 12). The genus *Cephus*, in Westwood, serves equally to connect the *Tenthredinidæ* with the next family *Uroceridæ*. *Cephus pygmæus* (Fig. 13) of Europe is said to reside in the interior of the stems of wheat, and occasionally commits much injury to the plants. It is figured and mentioned here, as either it or an allied species may yet be discovered here. *Cephus bimaculatus*, Say (Fig. 14), is found here, but its habits have not yet been described. The family of the *Uroceridæ* are popularly known by the common name of "horntails," from the prominent horn-like process on the end of the abdomen of the male; the ovipositor of the female is attached to the middle of the abdomen. Some of these insects are of large size; the larvæ are cylindrical, fleshy grubs, feeding on wood in holes, or burrow; the pupæ are formed in their burrows in thin cocoons formed of silk mingled with refuse gnawings of wood and sawdust. The insect of *Urocerus albicornis* (Fig. 15) is black with the end of the antennæ white, and the legs are black and white. The insect is about one inch in length, and it has been taken on pine trees in July. An allied insect, *Urocerus nigri-*

cornis (Fig. 16), is rather common in some localities; it, however, has black antennæ; the head, thorax, and part of the abdomen are black, but the hinder part of the abdomen and legs are reddish-clay color. The fly itself is nearly an inch in length, and the wings are somewhat smoky. *Urocerus juvencus* of Europe is said to attack firs, and has been reported to do much injury to the trees. The insect of *Xyphidria* obtains its name from its sword-like ovipositor. *Xyphidria albicornis* (Fig. 17), or the white-horned *Xyphidria*, is found on trees of soft wood in August in Massachusetts. The larvæ are reported to bore into trees in a somewhat similar manner to the *Uroceridæ.* In the perfect insect of *Xyphidria* the prothorax is elongated into a neck. The insect is about 0.60 to 0.75 in length, with black head and a narrow white mark around the eyes; the body is also black, with five or six white spots on each side of the abdomen. The female of *Tremex* (*Sirex*) *columba*, or the "pigeon tremex," bores holes by means of her ovipositor in the wood of elm, pear, butternut, &c., in which she deposits her egg. The larvæ are yellowish, about an inch in length, and feed upon the wood. These insects when in the larva-state are frequently destroyed by large *Ichneumon* flies, having very long hair-like ovipositors and appendages. These insects are called *Rhyssa lunator* and *atrata*, and use their ovipositors to bore into the burrows made by the pigeon trimex to deposit their eggs in the larvæ, where they feed upon the juices of the *Tremex* grub. Frequently, however, the *Tremex* gets its ovipositor so far into the wood that it cannot withdraw it, and the insect perishes fastened to the tree-trunk. We have an example of this in the museum, where the dead insect is fastened to a piece of elm wood by its undrawn ovipositor. The *Ichneumon* itself also has frequently been found in the same position, dead, where it has been inserting its ovipositor in the larvæ of the *Tremex* and was unable to withdraw it. *Oryssus hæmorrhoidalis*, or the red-tailed *Oryssus*, is mentioned by Harris. The larvæ bore into the wood of the willow. The insect is 0.60 in length, rough before, but smooth behind. The last three segments of the body are blood-red, hence its name. The wings are clear and transparent, with a smoky, broad transverse band beyond the middle of the first pair.

Oryssus maurus is a very similar insect, but is of a dark or black color, with white on the legs and antennæ like *O. hæmorrhoidalis.* Not having either of these insects in our collection we have figured another European species, *Oryssus cornatus* (Fig. 18), from Westwood.

Insects of the family of the *Cynipidæ*, with a few exceptions (hereafter named), puncture the leaves, limbs, young stems, and roots of various plants and trees with their curiously formed ovipositors and insert an egg in the wound, together with a peculiar irritating fluid, which causes the production of tumors or galls of various sizes, shapes, and colors, many of the galls on our native oaks resembling red or white currants, small apples, or peaches. The interior of many of these galls is of a solid substance which furnishes the food of the young grub when hatched. These grubs live in cavities in the center of these galls, where they change into pupæ, and, when fully matured, eat their way out into the open air as perfect flies. Others, however, eat their way out of the hardened and indurated galls as larvæ and change into pupæ on or in the earth, and then make their final change as flies. One of our largest and most remarkable galls is made by a small fly, *Cynips confluens* (Fig. 19). This gall is of large size and rounded form, somewhat like a small apple, but without the depressions for stem and calyx; it is sometimes two inches in diameter, green and pulpy at first, but when ripe has a hard grayish-brown thin shell, with an interior like sponge, and a woody cocoon or

cell in the middle where the larvæ and pupa reside. One of the figures represents the gall as young, the other the gall as old and cut open to show the cell in the middle, and the next of a rose-cutting bee which is frequently found in such situations in Maryland. There are sometimes two broods in one season. *Cynips bicolor* (Fig. 20) is a small black and red gall-fly, which forms a mossy or hairy reddish gall on rose-bushes, the outside of which appears as if covered with a velvety red moss. This gall is sometimes known by the name of "Bedeguar," and was formerly used for medicinal purposes. When on the subject of the gall-flies, it might be well to mention that the gall of commerce is formed by a gall-fly and comes to us in the form of small round balls of a dark color, varying in size. These galls are produced by a small gall-fly, *Cynips quercifolis* (*Diplolepis*) *gallæ tinctoriæ* of Geoffry. The gall-fly pierces the shoot or young boughs of a small oak and deposits an egg in the wound. The larva growing within the gall or excrescence lives in an oval cell in the middle of the gall, changing into a pupa in this cell, and finally emerges into the open air from a hole gnawed through its covering by the insect itself. Those galls are most valued that are without holes; those which have been perforated by the insect are less valued, are gathered later, and are called white galls. Galls are imported principally from Smyrna and Aleppo; they are used in coloring black, and form one of the principal ingredients in making ink. In 1850 upwards of two hundred and seventy tons of oak-gall were brought to the British market, and most probably many of our native galls might be profitably used for dyeing and making ink. Osten Sacken says that if the same gall-fly attacks different oaks may it not in some cases produce different galls, and mentions two varieties of galls on different species of oak producing gall-flies almost identical in shape, form, and color. The rose is also attacked by another gall-fly, *Cynips* (*Rhodites*) *dichlocerus* (Fig. 21), the insect of which produces a prickly irregular swelling on the stem; it is, however, said to be destroyed by a chalcid parasite hymenopterous insect, *Callimone chrysochroa*.

Gall-flies belonging to the genus *Rhodites* are found on the rose-bushes, and Osten Sacken enumerates eight galls made by *Cynipidæ* on the different rose-bushes of this country. If these rose-galls should increase to such an extent as to become injurious to the plants, they can readily be cut off and burned as soon as they appear on the bushes; but when so numerous as they appear on the oaks, it would be almost impossible to destroy them unless they should be gathered and some use found for them. *Biarrhiza* is a wingless species of *Cynips*, which probably forms galls on the roots of oak. *Biarrhiza niger* of Fitch is very small, being .008 in length and of a black color.

Figites is said by Westwood to be parasitical upon the larva of a *Syrphus*, or two-winged fly, in Europe, and another of these insects is said to destroy the insects that injure the olive. The insects of the genus *Figites* are concluded to be true internal parasites, and the males have feathered antennæ. One of them is said to be parasitic in the larva of *Sarcophaga*, a flesh-fly. *Allotria victries* of Europe, another allied insect, is also parasitic, having been detected in the act of laying its eggs in the body of a rose-plant louse, or *Aphis*.

In this family, *Cynipidæ* (West.), will be found a very singularly formed insect, *Ibalia*, the abdomen of which is very much compressed and shaped like a saber; the hind legs are disproportionately long. It was very rare, only two species of this genus having been mentioned by Westwood in Europe. He, however, speaks of a third species from Georgia which may probably be *Ibalia maculipennis* (Fig. 22), and which was said to be from the United States.

Some of the family of the *Evanidæ* are very singularly formed, the head being of the usual size, the thorax is very large and thick, while the abdomen is exceedingly small and insignificant, being very short and compressed. They are said to be parasitic, living in the eggs of cockroaches. We have figured *Evania appendigaster* (Fig. 23), which is mentioned by Westwood as feeding on cockroaches.

Packard has taken both pupa and insect of *Evania lævigata* from the eggs of a cockroach, thus proving what Westwood had previously stated. *Fœnus jaculator*, of Europe, infests the nests of a species of *Crabo*, laying its eggs in the larvæ. The insect figured below as *Fœnus irritator* (Fig. 24) was sent by a noted entomologist, and therefore has been figured as giving some idea of the figure and form of the genus *Fœnus*. *F. jaculator*, of Europe, deposits its eggs in the *Crabronidæ*.

The female of *Pelecinus polycerator* (Fig. 25) is a very singularly formed insect, the body being extremely elongated and thin; hence its common name of *needle Ichneumon*. The abdomen is very much attenuated, black, and is usually carried in a curved form. The male is extremely rare, and its abdomen is said to be short and clavate; it is not definitely known upon what the insect feeds, although the female is tolerably abundant in Maryland. *Aulacades* of Cresson is said to form a close connecting-link between the minute *Ichneumon* and the *Evanidæ*. *A. nigriventrus* is figured in Packard.

Ichneumon larvæ are parasitical in the bodies of caterpillars and other insects, where their grubs feed in the bodies of other larvæ or pupæ, consuming the fatty matter and eventually killing their hosts. The larvæ of the *Ichneumon* flies are soft, footless grubs. The eggs are laid either in or on the insects they infest, and when hatched penetrate into the interior, where, as before stated, they feed upon the fatty substance only, and carefully avoid the vital parts until the grubs are nearly fully grown. The caterpillar or larva injured at first shows no sign of its internal parasite, but appears in perfect health, eating and moving about as usual, until later, when it appears lifeless, and dies, either in the larva or pupa state. The pupa of the *Ichneumon* fly sometimes is formed in the earth, in cocoon, in the body of the injured pupa itself, and eats its way out of the outer hardened skin as a perfect *Ichneumon* fly. The ovipositor of the female insect is frequently very long and bridle-shaped, protected by a sheath, in order to be enabled to thrust their eggs into the holes or chinks where their victims hide.

Ichneumon suturalis (Fig. 26) is said to destroy the army-worm, *Leucania unipuncta*. Even beetles and the other orders of insects do not escape from the *Ichneumon* flies, and the whole family of the *Ichneumonidæ* may be counted as among the best friends of the horticulturist and farmer.

We have figured *Ichneumon grandis* (Fig. 27) as a large and well developed species that was taken in Maryland. *Trogus exesorius* (Fig. 28), another *Ichneumon* fly, is a very common species, and feeds in the caterpillar of *Papilio asterias*, the black and yellow "swallow-tailed" butter fly, so common in our gardens, the caterpillar of which, under the name of the parsley or celery worm, does so much injury to almost all the cruciferous plants, such as parsnip, fennel, dill, &c. The caterpillars of these worms are green, bounded with black and spotted with orange dots. These *Ichneumon* flies must be very useful, as they destroy multitudes of these noxious and disagreeable-smelling caterpillars. The insect of *Trogus exesorius* is of a clay color, having clouded, dark-colored wings. *Cryptus compunctor*, of Europe, deposits her eggs in the pupæ of butterflies, according to Westwood. *Cryptus inquisitor* (Fig. 29) destroys the *Thyri-*

dopteryx ephemeræformis, the hang or drop worm, and has been raised from its cases or hanging nests on the cedars in the Smithsonian grounds. *Thrygadenon* has its legs and antennæ somewhat thickened and simple; the abdomen is petiolated, and the ovipositor is exserted and somewhat long. Dr. Fitch states that five of these larvæ came out of a cocoon made by *Tolype* (*Planosa*) *laricis*, or the moth of the larch-cheater, each of them having gnawed a round hole through its cocoon. *Hemiteles*, a small *Ichneumon* fly, is recorded as having been raised from eggs of *Clisiocampa americana*, or the lackey caterpillar of Harris. They are also said to be parasitic in spiders' nests, in Europe, and Ratzeburg gives a list of fourteen ichneumous parasites in spiders; he also says that *Hemiteles fulvipes* (Fig. 30), of Europe, is parasitic in *Microgaster nemorum* of Europe, which is also a very minute hymenopterous insect like itself. *Pezomachus minimus*, of Walsh, is also a very small insect. It is said to be apterous, or wingless, and has been reported destroying *Lucania unipuncta*, or the Western army-worm or caterpillar. When about to change into the chrysalis they eat small holes through the skin of their victims, out of which they emerge and spin small cocoons on the sides of the dying caterpillars. These are symmetrically arranged side by side and enveloped in a floss. *Pezomachus agilis* (Fig. 31), of Europe, as figured below from Ratzeburg, is given, so that our readers may form some idea of the size and form of these insects.

Rhyssa (*Pimpla*) *lunator* (Fig. 32) is so called from the crescent-like marks across the body. The ovipositor of the female is extraordinarily long and bristle-formed, and when the insect is depositing its egg is bent downward so that its point touches the desired spot. The two sheaths of the ovipositor do not enter the tree, but pass down each side of the ovipositor to give it strength, and are held in position and stiffened by the hinder thighs, through which they pass. In this way the ovipositor is sometimes passed four or five inches into the solid wood, and sometimes becomes so firmly fastened to the tree that the insect cannot withdraw its ovipositor, but dies with it fast in the wood. The male *Rhyssa* (*Pimpla*) *lunator* (Fig. 33) is entirely different from the female in size and shape, being much shorter-bodied yet more slender in form. These insects are parasitic in habits, and feed as larva upon the larvæ of the pigeon *Tremex* or other wood-boring insects.

Rhyssa (*Pimpla*) *atrata* resembles *R. lunator* in form and habits, but is of a dark or black color, with clouded wings. *Pimpla pedalis* (Fig. 34) of Cresson is parasitic on *Clisiocampa* (lepidoptera); its ovipositor is half the length of its abdomen. *Exetastes fulvipes* (Fig. 35) of Europe is said by Ratzeburg to be parasitic in a *Lyda*, a hymenopterous insect mentioned in a former part of this report. In Ophion the antennæ are as long as the body, the abdomen is compressed, and the insects are generally of a honey-yellow color. The female of *Ophion macrurum* (Fig. 36) is reported to lay her eggs on the skin of the caterpillar of *Telea* (*Attacus*) *polyphemus*, one of our largest moths, and the larvæ or grubs hatched from these feed upon the fatty portions of the worm, avoiding the vital parts until the last, when the infested caterpillar has spun its cocoon. The parasitic larva then attacks the rest of it, and eventually kills it, when it leaves its dead victim and spins an oval dark-brown case or cocoon in which it changes into a pupa and eats its way out in the following spring.

The larvæ of another parasite, *Ophion bilineatus* (Fig. 37), destroys *Spilosoma virginica*, a medium-sized white moth or miller, with black dots on its wings, while *O. purgata*, very common in Maryland, is destructive to *Leucania unipuncta*, or an army-worm feeding on grass, grain, &c.

Porizon conotracheli, or the curculio parasite of Riley, is reported as

destroying the plum weevil, or curculio, *Conotrachelus nenuphar*, a small beetle very injurious to the plum and other fruits. The larvæ destroy the grubs of this destructive beetle. The cocoon is said to be more yellow than that of *Sigalphus curculionis*, another hymenopterous parasite to be described hereafter as destroying the plum-curculio. The perfect fly of the *Porizon* is reported not to appear in the winged state until the following spring. The insect is from 0.28 to 0.32 in alar expanse, and 0.18 to 0.22 in length of body; the head is black, the abdomen rufous, the peduncle black, and the legs are pale yellowish. *Sigalphus curculionis*, another small ichneumon or parasitic four-winged fly, is reported to be also a true parasite on the plum-curculio. This insect is somewhat allied to *Bracon*. The larvæ, after destroying the larvæ or grubs of the curculio, incloses itself in a small, tough, yellowish cocoon of silk, in which it changes into a pupa, and about the time the true curculio should appear the insect gnaws a hole through its cocoon, and appears as a small four-winged black fly. Mr. Riley estimated one year that three-fourths of the early-developed curculio larvæ were destroyed by this parasite in the neighborhood of Saint Louis. The insect is also reported to attack the small plum-moths. The female fly is 0.15 to 0.16 in length, and in alar expanse 0.30. The insect is black in color; the legs are pale and rufous, with the upper part of the tibiæ and tarsi dusky. A small parasitic four-winged fly, *Bracon palpebrator* (Fig. 38), is mentioned by Ratzeburg as destroying the *Curculio notatus* of Europe, and a small fly with black head and thorax, red abdomen and clouded wings, and three long setæ or bristles at the end of its abdomen as ovipositor and appendages. *Lamprosoma americana* (Fig. 39) was taken abundantly on wood-piles in Washington, where they were busily employed in depositing their eggs in passages bored by other wood-eating insects.

Another very small four-winged fly, allied to *Bracon* (Fig. 40), was hatched out of small parchment-like cocoons fitting into the passages made by other wood-boring insects, and spun in the slender galleries where the rightful tenants had previously been destroyed.

Rogas differs from *Bracon* in having the three first abdominal rings long, forming a slender *petioli*, according to Mr. Packard, but as we possess no specimen the figure cannot be given here. *Microgaster* and its allies contain four-winged parasitic flies, very beneficial to the farmer, as they destroy myriads of other noxious insects. *Microgaster nephoptericis* is reported as parasitic in a nephopteryx, a lepidopterous insect or moth, but it is found also in the cells of humble bees. Another Microgaster has been found in the caterpillar of *Chœrocampa* (*Sphinx*) *pampinatrix*, the hog-caterpillar of the grape-vine; another destroys the larvæ of the army-worm, of butterflies, moths, and even spiders themselves. *Microgaster congregata* (Fig. 41) destroys the caterpillar of the potato, tomato, and tobacco worms—*Macrosita* (*Sphinx*) *quinquemaculata* and *Carolina*. The minute dark-colored, almost black, female fly first punctures the skin of these caterpillars in many places and deposits her eggs in these punctures. The small footless grubs hatched from their eggs feed upon the internal fatty substances of the caterpillars until they attain full growth, when they eat their way out of the skin and form small, oval, white egg-like cocoons on the outside and fastened to the dying tobacco-worm. The perfect flies appear in a few weeks, and sometimes much earlier, especially in hot summer weather. Many caterpillars are frequently seen almost perfectly covered with these small egg-like cocoons, and attract much attention. When caterpillars are found thus infested with egg-like cocoons they should not be killed but carefully preserved, as, if protected, they will produce hundreds of these flies which

destroy hundreds of the caterpillars feeding on potatoes, tomatoes, and tobacco. The figure given here represents only a very small tobacco-worm, as a full-sized figure would take up too much space and would be no better than a smaller caterpillar.

Alysia rubiceps (Fig. 42) of Europe is mentioned by Ratzeburg as being parasitic in the body of a small beetle *Magdalus*, while *Praon viburnaphis* is mentioned by Tiber as preying on the aphis or plant-louse of the high-bush cranberry. This insect is only 0.15 in alar expanse; it is black in color, and has a short abdominal pedicel; the anterior legs are of a wax yellow, and the wings are hyaline.

Trioxys is also mentioned by Fitch as destroying plant-lice on the willow, poplar, cherry, and other trees. The *Aphidius* or *Trioxys* of the cherry is mentioned as having a somewhat singular habit; the larvæ, after devouring the interior of the body of the aphis, spins a thin cocoon between the dead body and the leaf. The insect is only 0.07 in length, and the antennæ are almost as long as the body; the insect is black; the palpi and legs are pale yellow-brown.

A parasitic insect attacks the *Hippodamia* (*Coccinella*) *maculata* (Fig. 43) or spotted lady-bird in a very similar manner, and was taken in Maryland. The larvæ of *Aphidius* also destroy plant-lice (*Aphides.*) The female fly deposits a single egg, by means of her ovipositor, in a plant-louse where the larva or grub when hatched devours the interior of the insect; the pupa is formed in the hollow shell or hardened skin, and, when ready to change, the perfect four-winged minute fly emerges out of a round hole gnawed through the skin, and which sometimes resembles a circular lid or trap-door. The plant-lice attacked by these parasites are readily known by their swollen form and brown or darker appearance. When a plant-louse has been stung by the parasite, it is said to leave the rest of the crowd, swell, and fix its claws in the leaf. It eventually dries up, with the skin very much swollen and the living parasite within its hollow body.

Aphidius triticaphis (Fig. 44) destroys the plant-lice on the wheat. *A. avenæ* attacks the oat-aphis of Europe, and in short almost all plants attacked by plant-lice have their peculiar parasitic small aphidians, or other fly or insect, to destroy them and thus preserve the crops, which would otherwise be totally ruined by the plant-lice, which multiply so rapidly, as witness the lice on hops, cabbage, fruit trees, and almost every other vegetable production.

Aphelinus (Fig. 45) is a small parasitic fly, which was found destroying *Chrysopa*, a neuropterous insect, which was bred in Maryland and formed a cocoon on a small shrub.

Chalcis (*Aphelinus*) *mytilaspis* is mentioned by Le Baron as destroying the apple bark-louse. In Europe a *Chalcis* is reported by Westwood to be parasitic in the eggs of the *nantis* or rear-horse. Another destroys the eggs of *Œdipoda carolina*, a species of grasshopper. Three species lay their eggs in the body of the caterpillar of *Ceratina* (lepidoptera), and emerge from the larva and pupa skin often in great numbers. According to Dr. Packard, another insect of this genus destroys the *Cecidomyia*, or gnat of the cranberry, and *Chalcis maria* is parasitic on *Telea polyphemus* and *Platysamia cecropia*. These insects are very numerous, forty-seven having been taken out of a cocoon of a *Polyphemus*, of which twenty-three were females.

Chalcis albifrons is reported to destroy *Pezomachns*, a small parasitic four-winged fly, before mentioned, and which itself is said to destroy *Leucania imipuncta*, or the army-worm, and another unnamed species is said to prey on *Ichneumon unifasciatorius*, which destroys *Acronycta*

oblinita, a moth or miller. These flies are said by Mr. Riley to be very minute and of a steel blue color, with honey yellow legs, and to issue in great numbers through very minute holes in the caterpillars' skins. These facts prove that many of the parasites preying upon insects are themselves preyed upon by other insects as ravenous as themselves.

Chalcis flavipes (Fig 46) is a small insect, black in color, of a rather stout form, and having very swollen hind black thighs, with a yellow mark near the knee. Some of these are capable of springing like fleas when disturbed.

Eurytoma (*Isosoma*) *hordei* (Fig. 47) the joint-worm, or barley-straw insect, is sometimes exceedingly destructive to the crops of wheat, barley, &c., the losses sometimes amounting to two-thirds of the whole crop. It was very destructive in Virginia several years ago, but we have not received many complaints about its ravages lately. The injury to the plants is caused by the abstraction of the sap from the ear, in order to form the swelling or gall, and, by the large amount of sap consumed by the larva, causing the deformity in the stem.

The larvæ of this insect reside in woody swellings or galls in the barley or wheat straw; the tumor or gall being generally found in a joint, or very near it, gives the insect the local name of joint-worm. This irregular swelling or collection of knots contains several small cells, varying from six to ten in number, each containing a single grub or larva. In a short time, when the larva has consumed all the sap it requires as food, the pupa is formed in the same cell and eventually the perfect insect gnaws its way out of the swelling and emerges as a minute black fly to deposit its eggs in other plants. This occurs in February, March, or May, in Virginia.

The larva is about one-eighth of an inch in length, of a pale-yellow color, and heavy dark-brown jaws. The fly is about 0.12 or 0.13 in length, of a black color with a smooth hind body; the thighs, shanks, and claw joints are blackish, while the knees and other joints are pale yellow. Mr. Walsh once thought that this injury to the crops was caused by a gall-gnat, two-winged fly (*Cecidomyia*), and that the insect now known as the joint-worm was merely a parasitic fly that destroyed the cecidomyia. To this, however, we must say that although hundreds of stalks were closely examined we never found a cecidomyia larva, pupa, or insect remains in the knotty swellings containing the *Isosoma*.

It is true other insects were discovered, such as *Semiotellus*, but these proved to be parasites of the *I. hordei* itself. It is, however, true that the genus *Eurytoma* (or *Isosoma*) contains generally parasitic insects, Mr. Walsh enumerating five species alone that are parasitic in twenty-four different galls. *Eurytoma flavipes*, or the yellow barley-fly of Fitch, differs merely from the *E. hordei* by having yellow legs and antennæ, and by the antennæ of the female not being surrounded by whorls of hairs.

E. secalis, or the rye-joint worm which is named the Rye-joint worm, differs by having the hind pair of shanks dull yellow; and *E. fulvipes*, which also differs slightly in several minor particulars, are enumerated as distinct species; yet may not these apparent differences be caused by variety of food or habit of the above-named joint-worms, as their habits are almost precisely the same as the Virginia species *E. hordei*? These insects are very subject to be destroyed by small parasitic four-winged flies, *Semiotellus*, &c. In order to destroy these insects it has been recommended to burn all the stubble off the ground before the following summer or as soon as possible after the harvest is in, and to burn all the tailings of the grain and the refuse straw after thrashing, as the insect

does not appear to be killed by frost or snow, and has been produced abundantly from straw made into manure by being rotted in the stable and then thrown on the manure-heap and exposed all winter.

Isosoma vitis, or the grape-seed maggot, is reported as destroying the fruit of the grape-vine. Mr. Saunders states that this insect is also in Canada, where it appears from the middle of July to August, and affected the Clinton and Delaware grape. The female insect is very small, being only 0.10 in length and the male 0.6; they are of a black color, with pale brown and black legs. The eggs are deposited on the skin of the grape. The larva punctures it and works its way to the middle of the fruit, and then enters the seed while young and soft and eats its interior; the larva then remains in the seed and changes into the perfect fly in July and August. The remedy recommended for its destruction is to destroy all shriveled fruits as soon as observed.

Leucospis affinis (Fig. 48) is a medium-sized chalcis, remarkable for having its ovipositor laid upon the upper surface of its abdomen, which is spotted and banded with yellow resembling a wasp. Say observed *Leucospis affinis* running actively over the surface of a rafter in a barn, busily feeling with its antennæ for a proper situation in which to deposit its eggs; having found a suitable place, the insect, after some exertion, suddenly disengaged the oviduct from the groove and valves and gradually thrust the instrument into the wood nearly to its base. Then having remained a short time at rest, probably in order to produce the egg, the oviduct was withdrawn, adjusted into its dorsal groove, and the insect proceeded again as before in search of another spot suitable for its purpose. Say, however, could not ascertain the kind of larva within the wood that received these eggs. The insects of *Leucospis fraterna* of Say, a cloudy allied species, are said to be obtained chiefly on blossoms of the parsnip. Westwood states that the anterior wings of a Leucospis are folded longitudinally when at rest. *Leucospis poeyi*, of Cuba, is stated by Packard to be parasitic in the nest of Megachile, a wild bee. *L. dorsigera*, of Europe, is said to deposit its eggs in the nests of a mason bee, and *L. gigas* in the nests of wasps.

Macroglenus penetrans (Fig. 49) is said to be parasitic in *Cecidomyia* (*Diplosis*) *tritici* the wheat-midge in Europe. This insect is figured from Curtis, as a similar or allied insect may yet be found in our wheat-fields, and ought to be recognized by the farmers as a beneficial insect. *Torymus harrisii* is reported by Dr. Fitch to be parasitic in the *Eurytoma* (*Isosoma*) *hordei*. The insect deposits its eggs in the larvæ, and the grub hatched from them devours the interiors, thus proving a friend to the farmer. Another Torymus feeds also in the nests of wild bees, *Osmia*, &c. Ratzeburg also mentions a Torymus in Europe which is said to be parasitic in a Tortrix or small moth, and yet others that destroy a *Bombyx* or moth and *Tenthredo* and probably *Cryptus*, an hymenopterous insect. *Torymus obsoletus* (Fig. 50) is figured from Ratzeburg. *Perelampis* is also a chalcid parasite mentioned by Dr. Packard; the antennæ are short and jointed, and when at rest lie in a deep frontal furrow; the head is large, abdomen contracted and slightly peduncled. The ovipositor is concealed, and the insect is of sherry metallic tints. *Perilampis triangularis* (Fig. 51) found in Maryland is here figured. Westwood states that in Pteromalus the femora slender, the ovipositor concealed or securely exserted, and the antennæ are 13-jointed with the third and fourth joints annular, and the fifth of moderate size. These small insects are exceedingly useful by destroying many noxious insects of several orders. They frequently lay their eggs in the eggs of butterflies, *Pteromalus vanessæ* being parasitic in *Vanessa antiopa*, a common butterfly.

P. clisiocampæ destroy clisiocampa, a tent-caterpillar. One species in Europe, *P. pini*, is reported to be parasitic in *Curculio notatus*, a European beetle, while another in the United States feeds in the larvæ of *Erytoma* (*Isosoma*) *hordei*, or the destructive joint-worm. *Pteromalus micans* (Fig. 52) of Europe is said by Curtis to destroy *Chlorops*, or two-winged fly, injurious to grain. *Pteromalus puparum* is exceedingly useful in the United States to gardeners, as it destroys *Pieris rapæ*, or the imported white cabbage butterfly, lately so injurious to the cabbage-crop of the Northern and Eastern States. The whole stock of eggs are reported to be deposited in the newly-hatched pupæ of *Pieris rapæ;* these hatch out into minute grubs or maggots that destroy the pupa or chrysalis and then reappear as minute four-winged flies, to again deposit their eggs in other insects. A species of *Pteromalus* is said by Westwood to destroy the egg capsules of *Blatta americana* or cockroach, and Ratzeburg mentions another as parasitic in spiders. This insect, *Pteromalus*, is very useful to farmers by destroying many of the small enemies of his crops, and should be prized accordingly as one of his friends. A species of *Eulaphus* with simple antennæ in both sexes is said by Westwood to destroy cockroaches, not less than seventy individuals having once burst forth from the egg capsule of *Blatta americana*, the eggs of which must have been deposited during the voyage. One species of *Eulaphus* is said also to be parasitic in a magdalis or beetle in Europe. The *Proctotrupidæ* consist of very small insects having their fore wings either destitute of or having very few veins; they are slenderer than the *Chalcididæ* in form, and generally parasitic in the eggs of other insects, and destroy gall and fungus-eating flies. One species is described as destroying *Lasiopteryx vitis*, a dipterous two-winged gall insect on the grape-vine. *Diapria cecidomyiarum* of Europe, another of the *Proclotrupidæ*, is parasitic in the larva of *Cecidomyia artemesiæ*, or the Artemesia gnat. In *Ceraphron* the abdomen has a very short pedicel. *Ceraphron destructor* was said by Harris to be very useful to farmers by destroying the larvæ of the Hessian fly, *Cecidomyia destructor*. The eggs are deposited in June in the maggot of the Hessian fly, and the perfect fly works its way out later in the season. This insect is said by entomological authorities not to be truly a *Ceraphron* or *Eurytoma*, but comes very near *Pteromalus* or *Rhaphiteles*. Insects of the genus *Teleas* are also very minute egg parasites; one of them is reported to destroy the eggs of a water-boatman. *Gerris* and *T. linnaei* is parasitic in the eggs of *Bombycidæ* (moths or millers). In Teleas the antennæ are clubbed and the legs are adapted for leaping.

Teleas læviusculus (Fig. 53) is figured from Ratzeburg to give some idea of the form and size of this insect. Platygaster, another of the *Proctotrupidæ*, has the abdomen often flattened. The antennæ are ten-jointed and club-formed; in the female the wings are without cells or veins, and the legs are not formed for leaping, as in *Teleas*. The insect is very minute, and the eggs are deposited in the eggs of the Hessian fly (*Cecidomyia destructor*). Notwithstanding these internal parasites, the egg of the Hessian fly hatches as usual, but the larva is unable to go through its usual transformations to the perfect fly, and dies after taking the flaxseed form. Meanwhile the intestinal foes are hatched, come to their growth, spin themselves little brown cocoons within the skins of their victims, and in due time eat their way out as perfect winged insects. When the larva is about to change to the pupa it assumes the form of a flax-seed case, in which, when not killed by the parasite, a pupa is formed, and in due time a four-winged minute fly. These flaxseed-shaped cases

are generally found between the sheath and straw at or near the bottom of the infested plants.

Another Platygaster destroys the eggs of the canker-worm (*Anisopteryx vernata*), the American tent-caterpillar (*Clisiocampa americana*), and one is recorded as destroying a scale insect or *Coccus* (*Lecanium*). *Platygaster tipulæ* (Fig. 54), from Europe, parasite in a *Tipulæ*. A two-winged fly is here figured from Ratzeburg to show the size and form of one of these insects, as we have no authenticated specimen in our entomological collection. In *Inostemma* the club of the antenna is clavate in the female, and the abdomen is furnished with a horn on the last segment of the body.

Platygaster inserens (Fig. 55) is also exceedingly minute, and in Europe is supposed to destroy the eggs of the wheat-midge, *Cecidomyia* (*Diplosis*) *tritici*. The family *Chrysididæ* of Leach, usually called cuckoo-flies, contains insects of small or moderate size, and of brilliant metallic, blue, green, and ruby tints. They obtain their common name of cuckoo-flies from their habit of depositing their eggs, not in the bodies of other insects, but in the nests of different fossorial bees and other *Hymenoptera*, where they starve out the original proprietors by devouring their store of food, and are what Mr. Walsh correctly called gnat-flies. Other authorities, however, state that they are truly parasitical and feed upon the bodies of other larvæ. *Chrysis bella* is said to be parasitical on *Eumenes fraterna*, or the potter wasp.

Westwood states that in *Chrysis* the abdomen appears to consist of only three segments, and its extremity is terminated by a series of denticulations. The ovipositor of some of the female *Chrysididæ* forms a long, large-jointed sting, which, however, is said not to possess a poison-bag. *Chrysis nitidula* (Fig. 56) was taken in Maryland. *Chrysis hilaris* is mentioned by Dr. Packard as being a short, thick, bluish-green species found in New England, 0.32 in length, with its abdomen hollowed out beneath and tip broad and square. These insects are also sometimes called golden or ruby tailed flies, from the color of some of the species, and the abdomen being concave beneath, if disturbed the insect is able to roll itself up into a ball like a hedgehog, presenting only its hard back and wings to any other insect attempting to assail it. Another genus is *Hedychrum* of Latreille, in which the body is semi-circular or nearly hemispheric, and the thorax broadly truncate in front. Insects of this genus have been recorded in Europe as depositing their eggs in galls in the nest of a megachili or wild bee, and in *P. sen*, a hymenopterous insect hereafter spoken of. An insect thought to be *Hedychrum Zimmermanni* (Fig. 57) of Maryland is here figured.

The second section of the *Hymenoptera* of Westwood is called *Aculeata* by Latreille, and is distinguished by the females (and neuters of such species as live in societies) having the organ of oviposition converted into a sting connected with poisonous glands in both females and neuters. These organs have been subdivided into two groups, viz., those living in societies having individuals of the neuter sex, and those solitary in habits and consisting only of males and females. Westwood in his classification commences with the *Crabronidæ*, the wood or sand wasps. These insects are of moderate size and resemble wasps in appearance and coloration. They are generally of very active habits. Dr. Packard commences the *Crabronidæ* with *Philanthus apivorus* of Europe, an insect which provisions its nest with honey-bees, and, therefore, may be considered as injurious by those individuals who raise bees for honey. He afterward mentions a *Cerceris* in Europe which also is known to store its nest with bees and also with the larvæ of *Curculionidæ* and *Buprestidæ* (co-

leopterous insect), thirty nests of *C. bupresticida* having been unearthed in a single field, which contained ten species of *Buprestidæ* comprising four hundred individuals. *Cerceris desertæ* is here figured as being one of the most common species found in Maryland (Fig. 58). In *Crabro* the head is large and nearly square, as viewed from above, and the mandibles have the outer edge but slightly curved and not with deep incisions as in the *Larridæ*. According to Westwood, one species of *Crabro* forms its nest in partially decayed wood, and in one stick. Mr. Walsh found several dozens of nests of a small species of wood-wasps, from which, the ensuing summer, he bred a dozen of the perfect insect. Another species is said to provision its nest with the bodies of plant-lice (*Aphides*) in Europe. *Crabro sexmaculatus* burrows in decayed wood in June, and another species was seen boring into a post. *Crabro architectus* (Fig. 59) of Say is here figured *Crabro;* in Europe, bores into palings, posts, willow stumps, &c., and provisions its nest with a small *Pyralis* or moth feeding on oaks; another on two-winged flies, *Anthomyia pluvialis*, &c., and on blue-bottle flies, &c. *Psen* is regarded by Dr. Packard as merely a degraded *Cerceris*, and in Europe some of them appear to nidificate in sand; others are wood-burrowers, and provision their cells with homopterous insects, *Aphides*, &c.

In the *Crabronidæ* Dr. Packard includes in his work *Rhopalum pedicellatum*, bred from the stems of rose, cocoras, japonica, and spirea; *Stigma fraterna* burrows in the stems of syringa; *Cremonus inornatus* burrows in elder, and *Passalœcus mandibularis*, burrows in stems of alder and syringa. The subfamily of *Nyssonidæ* of Leach, in Westwood, have the abdomen of an ovoid conic or conical form, being broadest at the base and never attached to the thorax by a long pedicel; the head is moderate in size, antennæ filiform, and mandibles not strongly notched on the outside at the base.

Trypoxylon is distinguished by its reniform eyes, its long narrow peduncled abdomen. The mandibles are toothless. One species in Europe destroys spiders. *Trypoxylon frigidum* lives in the stems of syringa. *Trypoxylon clavatum*, here figured (Fig. 60), was taken in Maryland. In Europe a species was detected frequenting holes occupied by a species of *Odynerus*, a hymenopterous insect, carrying a small round ball or pellet consisting of about fifty aphides or plant-lice. The genus *Goryles* resembles closely the genus *Odynerus;* the abdomen is elongate ovate, and the mandibles are two-toothed. The insects frequent flowers of the spirea late in summer, and in Europe are found on umbelliferous plants in summer; in Europe one was observed carrying off the larva of an *Aphrophora* or spittle insect, after trying to dislodge another larva from the drops of froth made by the insect. *Mellinus bimaculatus* was taken in Maryland on flowers in autumn, and is a small, slight, wasp-like insect of a black color, with a small yellow spot on each side of its abdomen. *Osybelus emarginatus* (Fig. 61) was also taken on flowers about the same time, and is reported to be common on the Virginia creeper; it is said to have two oval membranous appendages to the metathorax. In Europe the food of an *Osybelus* consists of *Diptera* (two-winged flies), and Westwood states that it has a peculiar way of carrying its prey while opening the mouth of its burrow or forming a new one. It uses its two fore legs in making its hole with great rapidity, moving them alternately and scratching a burrow sufficiently deep to cover itself.

Stizus speciosus very much resembles an immense wasp or hornet, and is very abundant on the Agricultural grounds in Washington, where they dig deep holes in the ground, in which they bury locusts, or more properly harvest-flies (*Cicada*). These insects are armed with very powerful

curved stings, and are commonly but improperly known as hornets; they are also called digger-wasps, and in Texas "horse-guards." They are very rapacious in habits, paralyzing the locusts or *Cicadas* or large grasshoppers with their powerful stings, and then carrying their victims off to provision their nests and serve as food for their young grubs or larvæ when hatched. The insects themselves have been seen feeding on the sap of trees. This insect measures more than an inch in length. The head, thorax, and legs are of a dark-brown color, and the abdomen is black with broken bands of yellow. Mr. Walsh gave a very good description of the habits of *Stizus grandis*, a similar but larger insect than the *S. speciosus*, which will apply very well to our species. The "insect digs a hole in the ground as a nest; it then catches a locust (*Cicada*), stings it just enough to stupefy it, but not enough to kill, and drags it into the hole as food for its future young. It then deposits a single egg in the nest and closes up the hole with earth, then flies off to repeat the process until its stock of eggs is exhausted. The soft, white, legless larva when hatched out, gradually devours the body of the living locust, and when full-fed it spins a membranous cocoon in which it passes the winter, and comes out as a perfect wasp the next spring." We have frequently seen this insect in the act of carrying the yet living body of the locust (*Cicada*) and burying it in holes in the departmental grounds. Westwood states that *Stizus* appears to form a connecting link between the *Bembycidæ* and the *Scoliidæ*, mentioned afterward.

The family of the *Larridæ* is of small extent, and the species are of small or moderate size. *Larridæ argentata*, a small wasp-shaped insect, is covered with a silver pile. It is a slender form with short, nearly unarmed legs. A specimen was taken near the agricultural college in Maryland (Fig. 62), busily employed in dragging a still living but partially paralyzed cricket (which was much larger than itself) to its nest. Some of this family are said to frequent the Asclepius flowers, the pollen of which is sometimes found adhering to their feet. This fact we ourselves have observed in several instances when examining insects frequenting this plant. Westwood states that there are no British species of *Bembex*, but observes that the family of the *Bembycidæ* contains insects of moderate size, some few, however, being nearly as large as any known *Hymenoptera*, and that they generally are inhabitants of hot climates. The females burrow in the sand and bury various species of *Diptera* (two winged flies), *Syrphidæ*, *Muscidæ*, &c., depositing their eggs in them, and when a sufficient store has been collected the parent closes the cell with earth.

In Europe, *Bembex* is subject to the parasitic attacks of *Panorpes carmea* and *Toxophora*, a dipterous insect. *Bembex larsala*, according to Latreille, provisions its nest with bee-flies, *Bombylii* (two-winged flies). *Bembex fasciatus*, sometimes called the bald-faced hornet, is reported to carry off and destroy *Musca cæsar*, a flesh-fly; it also catches common house-flies. The *Bembycidæ* have large heads, flattened bodies, and resemble *Syrphidæ* (two-winged flies), in coloration. *Bembex fasciata* (Fig. 63) was taken in Maryland on flowers, and is here figured; it is said to be very swift in flight, and is abundantly found in sandy places. Another insect of this family is *Monedula*, which, according to Dr. Packard, differs from *Bembex* by having a more slender body, more clovate antennæ, very obtuse labrum, and is more gayly spotted. *Monedula ventralis* (Fig. 64) here figured was taken in Maryland in autumn.

The family *Sphegidæ* are distinguished by having the collar laterally dilated and extending as far as the base of the wings; some of them are among the largest of the *Hymenoptera*. They are restless and active,

and their sting is very powerful, paralyzing the insects with which they provision their nests without killing them outright, thus keeping a supply of fresh food for the use of their larvæ. Some of this family make their nests in sand, burrowing into it with their fossorial fore feet, while others build their nests, or rather cells, with mud, fastening them on walls, rafters, and loose boards. The genus *Pompilus* has the collar transversely or longitudinally square, the abdomen more or less oval and attached to the thorax by a very short pedicel or foot-stalk. The species *Pomphilus formosus* is known in Texas by the common name of the Tarantula killer, from its habit of carrying off and killing the large spider commonly (but erroneously) known as the Tarantula (*Mygale hentzii*), which is found in that State.

After depositing an egg in the body of the spider and burying it in the earth several inches in depth, it fills up the hole and leaves the egg to be hatched by the heat of the sun. During the summer this insect feeds on the flowers of the Virginia Creeper and Asclepias—milk or silk weed. These insects are generally black or of a deep blue color, with smoky or reddish wings and sometimes a reddish band on the abdomen, like the insect figured, *Pompilus tropicus* (Fig. 65). Westwood states that some European species also destroy ants as well as spiders. The genus *Cerapales* has a short abdomen, and the hind legs are very long. These insects have been supposed to be guest flies, or parasitic, feeding in the nests of other fossorial or earth-digging species. Abbott, however, figures one in Georgia attacking a spider. *Ceropales ruficollis* is said to have been bred from the mud-nest of Agenia. *Ceropales bipunctata* (Fig. 66) is here figured, and was taken in Maryland; its body and legs are black, while the hind thighs are of a red or orange-clay color. *Pelopæus* is of a slight form, and the abdominal peduncle is very long. These insects make mud-nests, which are composed of a number of small pellets of moist mud laid side by side or built up so as to form an earthen nest, in which living insects are deposited as food for their larvæ. These mud-cells are provisioned with spiders, caterpillars, and other insects, and the wasps making them are known as mud-wasps, or, more commonly, "dirt-daubers." These clay or mud cells are built against the walls of buildings, commonly under the eaves of the roof in barns or outhouses, or under rails, fences, or any place where they will be partially protected from the inclemency of the weather. *Pelopæus flavipes* provisions its nest with spiders, and the pupæ of a *Sarcophaga*, or two-winged fly, were also found in its cell. *Pelopæus ceruleus*, a dark blue species with clouded wings, is very common in some localities, literally dotting the walls and roofs of some old barns with the large clay nests (Fig. 67).

The perfect insect of *P. cementarius* (Fig. 68), a variety of *P. architectus*, is also figured, to show the general form of these insects.

In the genus *Sphex* the abdominal peduncle and insect are stouter in form than *Pelopæus*. The insect of *Sphex ichneumoneus* digs holes four to six inches in depth in gravelly walks, in which one was seen to deposit a kind of grasshopper (*Orchelimum*) as food for its young larvæ; it then threw in a little earth and flew away. *Sphex flavipes* (Fig. 69) is here figured as occurring in Maryland.

A species of *Sphex* in the island of Bourbon provisions its nest with *Blatta americana* (a cockroach), and *Sphex canieri* of Europe is said to construct a nest of cottony substance, filling a tunnel formed by a curved leaf.

In *Ammophila* the abdominal peduncle (or foot-stalk of the body) is very long and slender. The form of these insects is also slender and lengthened; the wings are somewhat small in proportion. They inhabit

sandy places. Mr. Westwood states that the *Ammophila sabulosa* of Europe stores its nest with large green caterpillars, spiders, &c., after forming a burrow in sandy soil, using its jaws in burrowing; and when the jaws are loaded with earth or sand the insect ascends backward to the mouth of its burrow, turns quickly round, flies to about a foot's distance, and throws the sand in a complete shower to about six inches' distance; it then again alights at the mouth of its burrow and repeats the operation of digging out its nest. *Ammophila gryphus* (Fig. 70), a large species, of a black color, with orange band on the abdomen, occurring in the District of Columbia, is here figured. *Chlorion cyaneum* is also classed by Dr. Packard among the *Sphegidæ*, and is of a blue color. The specimen figured was received from the Southern States, and probably in habits resembles the rest of the *Sphegidæ*. Insects of the genus *Pepsis* are generally of large size and indigo blue in color. *Pepsis elegans* (Fig. 71) occurs in the Southern States, and is remarkable for its thickened clay-red antennæ, the body and head and legs being of a dark metallic color, making a vivid contrast. The wings are also dark-colored, with two clay-colored spots on each upper wing and a smaller spot on each of the under. *Pepsis formosa*, of Texas and California, is said to be black, with bluish or greenish reflections, and is remarkable for its bright, fiery red wing.

The family of the *Scoliadæ* is distinguished by its broad front and its small indented, often lunate, eyes; the collar laterally extends to the base of its wings; the legs are short and robust; the antennæ are short and thick, or less serrated and convoluted in the females; the abdomen is elongate ovate and attached by a short pedicel. Both sexes are winged and the body is often very hirsute, and, from the structure of the legs, the females probably burrow in sand. *Scolia bicincta* in Europe is said to burrow in sand-banks to the depth of sixteen inches, and the nest is probably stored with locusts or grasshoppers. *Scolia flavifrons* of Europe is said to live in the body of a large beetle. *Oryctes nasicornis* and another species in Madagascar is also said to live in another. *Oryctes Scolia dubia* (Fig. 72) is here figured as being taken in Maryland; the head and front part of the abdomen is black and the hinder part reddish-brown, with a spot of light yellow on each side; the wings are each clouded with a lilac or blue tinge. In Europe these insects are abundant in the hottest situations and are particularly fond of strong-scented flowers, such as Rue, &c. *Typhia inornata* (Fig. 73) is common in Maryland in sandy places; it is a medium-sized, plain-looking, black, wasp-shaped insect, and was taken on flowers in Maryland. An insect of the genus in Europe made a perpendicular burrow in sandy places for the reception of her egg, but the food stored up for the larvæ was not observed.

In *Myzene* the form of the sexes is very dissimilar, the eyes of the male being large and lunate, while in the female small, remote, and entire. These insects frequent hot, sandy places. *Myzene sexcincta* (Fig. 74, male and female), a somewhat common species here, is figured. *Elis costalis*, a foreign species, lives in certain beetles and undergoes its metamorphoses in the formicary of *Acodoma* (a species of ant), in Mexico. *Elis quadrimaculatus* (Fig. 75), or a closely allied species, is here figured.

Insects of the family *Mutillidæ* are generally found in hot, sandy situations, running with great swiftness over the bare places, and when alarmed they hide themselves among stones and grass or weeds. In habits they are said to resemble the sand-wasps already described. The larvæ of *Mutilla europæa* are said to live parasitically in the nests of humble-bees. The insect, however, has been dug out of sand banks, but has never been observed in the act of burrowing.

Westwood states that a North American species, *Mutilla coccinea*, is very active, taking flies by surprise, probably for the sake of storing its nest. The sting is exceedingly powerful. The males of *Mutilla* are furnished with wings, but the females are apterous, or wingless, and remain upon the ground or fallen logs, while the males, being winged, are frequently taken on flowers. The wingless females of *M. unicolor* resemble ants in form, and are found as far north as Maine. The female of *Mutilla occidentalis* (Fig. 76) is of a beautiful scarlet color, and has a velvety appearance. The first part of the hind body, nearest the thorax, is black, and the abdomen is also broadly marked with a black or dark band. The male, also figured with the above, is winged. Professor Verrill found this species constructing deep holes in a hard-beaten path, and storing it with small insects. One of the family of *Mutillidæ*, in Texas, is known by the local name of cow-killer. Some of these insects exceedingly resemble ants, but may readily be distinguished by the antennæ, which are *not* geniculate-elbowed or formed like a flail. The family of the *Formicidæ* comprises the ants, the majority of which live in societies under ground. These communities are generally composed of three classes—namely, the males and females, both of which are furnished with wings, and the neuters, which perform all the work and are perfectly wingless. Their antennæ are long, slender, and elbowed or geniculate. In this neighborhood ants do not appear to store up a supply of grain for winter use, as is generally supposed, but live on small seeds, dead or disabled insects, &c., as it were from hand to mouth; and the grains of wheat said to be so plentifully found in the autumn in their nests are nothing but the cocoon or cases enveloping their larvæ or pupæ, and often erroneously called ants' eggs. Bird-fanciers in Germany collect these so-called eggs in great numbers as food for soft-billed singing birds. The ants' hills or nests are first knocked in pieces and scattered abroad, and pieces of bark and small branches of trees laid here and there upon the ground, when the ants diligently carry these so-called eggs into little heaps to preserve them from the sun and weather, where they are readily collected by the bird-fanciers, and sometimes dried in the oven for winter use. *Formica* of Linnæus is described as sting-wanting, and abdominal peduncle consisting of a single elevated scale, while *Myrmica* has the abdomen armed with a sting and has the abdominal peduncle two-jointed.

So many stories will be found in all our popular works on natural history about the slave-making propensities of various species of ants, together with their forays and battles, that we will not enlarge upon the subject in this report, but merely mention a few species that are remarkable for their destructive habits, peculiarities of structure, form, or mode of life. One of the largest species in this neighborhood, *Formica caryæ*, (Fig. 77, male and female), is of a black color, and inhabits hickory trees, boring passages in the wood, the sides of which are very much discolored and softened, probably by the formic acid emitted by these insects. The high-hole or yellow-winged woodpecker, in spring, if shot, and the stomach examined, will be found completely filled with the bodies of ants in all stages of digestion, gathered from the hollow forest-trees in the woods of Maryland, and smell most disagreeably of formic acid. *Formica pubescens* is mentioned in Canada as eating the wood of cedar trees and constructing partitions as thin as paper. *Formica pennsylvanica* is mentioned by Packard as the largest species, and is found on oaks and decayed trees, and *F. novæboracensis* is mentioned by Fitch as found with the apple-aphis or plant-louse on apple trees, and keeping in the society of the aphides for the sake of the sweet, sticky substance emitted by the plant-

louse, and which is eagerly devoured by the ants. On young fruit trees ants have been frequently accused of injuring the shoots and foliage' when they really only frequent such places for the so-called honey-dew above mentioned. On a Georgia cotton-plantation a large number of small ants were observed to kill and devour the grass army-worms, and let a small caterpillar or insect be in any way injured, it was sure to be attacked and eventually killed and dragged away by the ants.

Myrmica differs from *Formica*, as before stated, in having the abdominal peduncle not formed of only one scale but as having two joints, and being possessed of a sting.

Myrmica cerasi is a small ant, called by Fitch the cherry ant, from its frequenting the cherry trees, where it feeds on the sweet honey-like substance that exudes from the cherry plant-lice. The color of the neuters is dark brown, and the body is highly transparent, resembling rosin. The abdomen is black, highly polished, egg-shaped, and acutely pointed at its apex. The legs are likewise black.

Myrmica molesta is a small yellow ant, 0.06 in length, found throwing up hillocks of earth in gardens. It is reported sometimes to injure maize by gnawing the blades for the sake of the sweet juice. A similar insect is said to have been naturalized in England, and a very small yellow ant is very troublesome in Georgetown and Washington, swarming over the food, especially anything very sweet in pantries. A lady recommended for the destruction of these pests a very troublesome yet effectual remedy, viz: a large sponge must first be dipped in water and then gently squeezed and sprinkled with powdered sugar; this sponge must then be laid in the places frequented by the ants, and every quarter or half hour examined, and if covered with ants it should be plunged in boiling water and then again baited with the sugar. The lady said this plan was eminently successful, as in a few days her house was completely rid of these little pests. Where there are no eatables around in gardens, &c., the nests may be blown up by gunpowder, squibs, &c. If Paris green, mixed with cooked potatoes or their favorite food, be applied, the insects would certainly be poisoned, but great care should be taken when applying the poison. Drowning them out is of little use, as after an immersion of several hours the insects are apparently uninjured. A foreign species, *Myrmica* (*Alta*) *Carbalo*, is mentioned as storing the grain of a particular rice-like grass, and is said, also, to maintain a clear crop of this plant round its nest, suffering no weed to appear among it, and harvesting the crop at the proper time. The same is, however, said of *Myrmica molefaciens*, or the agricultural ant of Texas, which may be the same or a very similar insect. This ant is said by Mr. Lincecum to live in communities and to build paved cities, construct roads, to sustain a military force, and to clear away the grass and herbage and other litter to a distance of three or four feet around the entrance to their city, and to construct a pavement consisting of a pretty hard crust about half an inch thick, formed of coarse sand and grit; and no green herb is allowed to grow on this pavement excepting a grain-bearing grass, *Arista stricta*. This grain when ripe is harvested, the chaff removed, and the clean grain is carefully stored away in the dry cells. Lincecum even avers that the ants sow the grain. These two last accounts are so much alike that it would lead to the belief that they refer to the same insect under two different names.

The honey ant of Mexico, *Myrmecocistus mexicanus*, deserves a short notice here, as it is reported to have been found in parts of Texas also. This ant has two kinds of workers, of very distinct forms: one of the usual shape performing the active duties of the ant-nest; the other and

larger worker is inactive and does not quit the nest, its sole purpose apparently being to elaborate a kind of honey which they are said to discharge into receptacles, which constitutes the food of the entire population of the community. In the honey-secreting workers the abdomen is distended into a large globose bladder-like form; from this honey an agreeable drink is made by the Mexicans. The specimens from which these drawings were made were presented to the department by Professor Uhla, and appeared like small bladders filled with a yellowish-brown liquid, with only the head, throat, and legs of a small ant attached to the swollen bladder. The honey was sweet, with a slight taste of formic acid, and was quite clear when the insects were crushed and the bodies of the insects had been strained out of the honey. *Pheidole providens* of Westwood, according to Colonel Sykes, is a foreign ant, which collects so large a store of seeds as to last from January to October. *Œcodoma*, another ant, is said to be a great pest to agriculturists, as the insects strip trees of their leaves in order to convey them to their nests. *Œcodomo texiana* constructs tunnels and subterranean roads, and cuts the leaves from various fruit and forest trees.

Pseudomyrmica flavidula, a South American ant, lives in the spine which arms the stems of certain species of *Mimosa*, specimens of which were kindly donated to our museum by the Smithsonian Institution.

Insects of the family *Eumenedæ* have the basal segment of the abdomen narrowed and pear-shaped, and comprise solitary species of wasp-like insects, composed of males and females only. *Eumenes fraterna*, or the Potter wasp (Fig. 78, three figures), is very common in this neighborhood, and makes its cell of moist clay or mud. These cells or nests are about the size of a small cherry and are composed of pellets of mud, and are generally cemented to the stems or small branches of trees and shrubs, and sometimes even on a leaf.

These round flanked-shaped nests are filled with small caterpillars of the different *Lepidoptera;* frequently, in the Eastern States, of the living caterpillars of the canker-worm (*Anisopteryx vermata*). The caterpillars, after being first paralyzed by the sting of the wasp, are carefully stored up in the nest as fresh food for the larvæ of the wasp. Mr. Walsh states that he has seen as many as five of these nests all placed together on the lower surface of a leaf; we, however, have mostly found them solitary, or, at the most, two nests placed near each other.

In June the perfect potter wasp emerges from its cell and lays the foundation of other similar cells. We hatched a *Toxophora* (a two-winged parasitical fly) from the nest of *Eumenes fraterna*, where no doubt it had, as larva, destroyed its benefactor. A species of *Chrysis* (*Hymenoptera*) is also supposed to be parasitic on this insect. In *Odynerus* the abdomen is broad and conic; the basal segment short and somewhat bell-shaped. *Odynerus* (Fig. 79) *bireniimaculatus* from Maryland, is here figured. *Odynerus muraria* of Europe, forms a burrow in the sand to the depth of several inches, in which it constructs its cell, besides which it builds with the grains of sand brought up while burrowing, a tubular entrance to its burrow, often more than an inch long and more or less curved, the grains of sand of which it is formed being agglutinated together. This nest it stores with caterpillars and deposits an egg in each cell, and when the store of food is secured the insect closes the mouth of its burrow, employing the grains of sand of which the funnel is composed for that purpose. *Odynerus albophaleratus* of Saussure, builds separate cells half an inch in depth and a quarter of an inch in width, formed of small pellets of mud, giving them a corrugated appearance, and builds in deserted galls of a gall-wasp or *Cynips*. It has been found also in the deserted nest of a

Clisiocampa or tent caterpillar, and the pupa has also been taken in the deserted cells in a syringa-stem. The cocoon was made of silk without any mud cells. Various European species of *Odynerus* store their nests with different insects; one species uses flies as well as caterpillars of *Torlvix*, a small moth, and other *Lepidoptera*; another species uses the larvæ of *Chrysomela* (a beetle), and one species is mentioned as being destroyed by the larva of *Tachina*, a two-winged fly.

The *Vespiariæ* of Lerveille, or *Vespidæ*, according to Westwood, are restricted to those species which live in temporary societies, consisting of males, females, and workers, or neuters, including the common wasp and hornets. These societies are annual, only being dissolved at the approach of winter. Previous to the setting in of cold weather the females, which have but recently been developed, are impregnated by the males, which soon afterward die. The females then disperse, seek winter quarters in sheltered situations, and those which survive the rigors of winter, in spring commence the building of a new nest in which they deposit eggs and tend their young themselves—those at first consisting entirely of neuters, which assist their parents in the duties of the nest. These nests are either built under ground in holes, in banks, or are attached to branches of trees, or the woodwork of outhouses; some of them are composed of a paper-like substance formed of finely gnawed wood, or bark of trees reduced to a paste by the action of the jaws. These insects are voracious and prey on other insects, meat, fruit, honey, &c., which being properly prepared in the stomach of "the winged insects, is disgorged and serves as food for their young." The males are drones and perform no labor. The stings of wasps are very painful, but are very soon alleviated by the application of spirits of hartshorn or ammonia. The larvæ are fleshy grubs destitute of feet, and are each inclosed in separate cells and in a reversed position, having their heads downward in those species having hanging nests. The insects of *Vespa maculata*, or the bald-faced hornet, catch flies, &c., to feed their young, and construct nests of a material like paper made from wood fibers. The wasps with their powerful jaws gnaw off small filaments of wood from old fence-rails, posts, &c., which they chew into a pulp and spread out into sheets of a strong gray water-proof paper, which forms the material of their nests, and which are generally suspended from the branches of trees. They are frequently larger than a man's head, and of a globular form.

These nests are covered with an outer envelope of many irregular layers of paper. The inside consists of layers of hexagonal cells suspended from the top, and from those above, by numerous little pillars of the same *papier-maché*, leaving a passage-way between the different tiers of cells. These combs are placed in a horizontal position and contain each of them but a single egg, which, when hatched, becomes a larva suspended with its head and mouth downward in the mouth of the cell, and from which it is fed by the other wasps.

The communities consist of males, females, and neuters. Mr. Walsh also states, however, that some of the workers can and do generate without any intercourse whatever with the male. The nest figured (Fig. 80) is reduced in size. *Vespa germania* (Fig. 81) is figured from a specimen taken in Maryland. This species and *Vespa vulgaris* have indiscriminately been called "yellow-jackets." Mr. D. A. A. Nichols, of Westfield, N. Y., writes that the yellow-jackets in his neighborhood all build nests in trees or bushes and not in the ground as generally supposed. One nest was particularly mentioned as built near the roof of a grainary, and was 16 inches in diameter and 20 inches in length. Mr, Walsh, however,

states that all the species with which he is acquainted build in the ground.

Wasps are subject to the attack of several parasites. *Phipiphorus paradoxus* and the Lebia (a beetle), *Volucella*, a large two-winged fly, infest wasps' nests, and two species of *Ichneumon* flies, one of which is anomalous, infest the larvæ. Dr. Packard, however, states that no parasites have as yet been detected in this country.

Wasps and hornets frequently feed upon and injure ripe fruits. They are said also to destroy honey-bees, but are also beneficial by destroying flies and other insects. A species of wasp in the West Indies is said to be infested by a parasite plant or fungus which rises from the segments of the abdomen and other parts of the body, presenting the singular appearance of a living wasp carrying a living plant.

A somewhat similar fungoid growth from the head of a harvest-fly, or *Cicada*, has been presented to our museum, and in Australia a fungoid growth grows from the caterpillar of a moth. *Vespa crabro* (Fig. 82) builds its nest in decaying hollow trees, under the eaves of barns, and, according to Mr. Angus, of West Farms, has been introduced about New York Insects of the genus *Polistes* are much slenderer in form than the true wasps, and distinguished by having the first segment of the abdomen separated by a slight constriction from the second segment. The food of the perfect insect is partly vegetable and partly animal, consisting of honey, pollen, and various insects. The insects are mentioned as being great friends to the growers of tobacco, as destroying the caterpillars of the tobacco-worm (*Macrosila carolina*) when they are very small, in July and August, by carrying them off as food for their young, and are themselves destroyed by an *Asilus*, or large two-winged fly. Insects of the genus *Polistes*, according to Westwood, do not inclose their nests in a general inclosure like *Vespa*, but leave their cells exposed, attaching them to stems of plants, walls, &c., sidewise.

Polistes gallica (Fig. 83), of Europe, is said by St. Fargeau to build nests having cells filled with honey; and the nest figured has been figured from Westwood, as giving some idea of their style of building.

A foreign species, *Polistes lecheguana* (Fig. 84), is said to make an abundant supply of honey. A rather common species, *Polistes flavesps* (Fig. 85), is figured as from Maryland, together with a small unfinished nest. Say mentions *Polistes millifica*, which lives in a paper nest near Jalapa, and makes a kind of honey having a very pleasant taste. *Polistes rubrigenosa* (Fig. 86), of the United States, is mentioned by Riley as carrying off the larvæ of the Colorado potato-beetle, *Doryphora* (*Chrysomela*) *decemlineata*, to its nest as food for its young. The rest of this family, according to Westwood, consists of the bees, the larvæ of which feed exclusively on pollen and honey, and the insects of which consist of males, females, and drones or neuters; some of them live in societies, as the honey-bee; others, however, are solitary in habits, &c., and consist only of males and females without any neuters, the female building the nest, which is generally composed of a series of cylindrical cells for the reception of the eggs and pollen-paste to feed their young when hatched; and a third class, which are solitary and do not build nests at all, but deposit their eggs, cuckoo-like, in the already provisioned cells of other bees, when, by eating up the food laid up, they starve out and kill the rightful owners.

The *Andrenidæ*, form the first family of Westwood (subfam. *Obtusilingues*), in which *Colletes* is mentioned as having the females resembling the workers of the honey-bee. These insects form large colonies and burrow deep in the earth, at the end of which burrows are several car-

tridge-like cells, and each covered with a cap like the parchment on a drum-head. Westwood states that these insects nest in the earth and the softer parts of walls. Each nest is cylindrical, consisting of from two to four cells placed end to end, the bottom of one fitting into the mouth of that beneath it, and in each cell are deposited an egg and a quantity of pollen to serve as food for the larva when hatched. They are subject to the attacks of parasites in Europe, among which is *Millogramma*, a two-winged fly, and a cuckoo, or guest-fly, *Epeolus*. The second subfamily of Westwood (*Acutilingues*,) contains the genus *Sphecodes*, of which Dr. Packard states that the body is smooth and wasp-like, with the abdomen of a light-red color. Mr. F. Smith says that this genus builds cells, although it has been stated by some authorities in Europe to be parasitical on *Halictus* and *Andœna*. *Halictus* contains some very small species in England, sometimes of metallic colors. *Halictus parallelus*, of Say, excavates small deep holes, from six inches to a foot in depth, the cells of which are glazed within. The females are supposed to hibernate, and each larva is in a cell by itself, placed upon a lump of pollen on which it feeds. Westwood says that *Halictus terebrator* of Europe makes burrows in beaten tracts and deposits small balls of pollen slightly moistened with honey in cells with their eggs, and the burrows are often observed in great numbers placed close together. *Halictus ligatus* (Fig. 87) is figured as found in Maryland.

Andrena very much resembles the common hive-bees of Europe. They make their cells in light, sandy soil, five inches to a foot under ground, and deposit an egg in a mass of pollen, and when the eggs have been properly placed the female stops the mouth of her burrow. The habits of *Andrena vicina* have been described by Mr. Smith. The larvæ were taken full-grown in June, the pupæ were found the first of August, and the mature bee appeared the last of the same month. The female of *Andrena nigroœnea* (Fig. 88), of Europe, is figured from Westwood. *Andrena* is subject to parasitic insects which destroy it. *Stylops*, an insect now classed with the beetle, and *Braula cœca*, figured among the *Dipleia*, or two-winged flea, are mentioned as destroying this insect.

Professor Packard here mentions *Angochlora* as a beautiful, shining, metallic-green species, very commonly met with, and which forms a burrow, the last of June, about four inches in depth. *A. purus*, a small green species, is found in Salem, Mass.

Prosapis is mentioned by Mr. Smith, who states that this genus is not parasitical, as formerly supposed, as he has repeatedly bred them from cells laid in regular order in the hollow of bramble-stems.

Mr. Saunders, of Canada, also says they construct their cells in bramble-sticks, which they bore in the same manner as *Colletes*, with a thin, transparent membrane, calculated for holding semi-liquid honey, which they store up for their young. These insects are much attacked by a *Stylops*, before mentioned.

In the genus *Sphecodes*, Dr. Packard states that the body is smooth and wasp-like, with the abdomen light-red. Mr. F. Smith says that this genus builds cells, although it has been stated to be parasitical on *Halictus* and *Andrena*.

Family 2, *Apidæ*, or bees, of Westwood (subfam. 1, *Andrenoides*), contains the genus *Panurgus*, the insects of which are stated to "revel in honey-pollen of a large anthemis, and to be attached to semi-flocculent flowers"; they are furnished with a pollen-plate on each side of the metathorax, and another on the posterior femora, and the hind legs have also pollen-brushes.

Subfamily 2, *Denudatæ*, of Westwood, contains the naked, or smooth

bees, or those not clothed with long hairs. The genus *Nomada* contains gayly colored bees resembling wasps. They are destitute of hairs, and have no instrument for conveying pollen. In Europe they frequent dry, sunny banks, and are generally known as guest, or cuckoo bees, as they are said to be parasitical in the nests of other bees, feeding upon the pollen laid up for the young larvæ of the rightful proprietors. They are reported to infest the nests of *Andrena*, *Panurgus*, and *Eucrga*, in Europe; the females do not sting severely, and give out a sweet scent.

Nomada imbuicata and *pulchella* have been found in the nest of *Andrena vicina*, and *Nomada pulchella* in the cells of *Halictus paralillus*. In both these cases it appears that the larvæ of *Nomada* must feed on the pollen-mass destined for the other bees, but Dr. Packard adds, however, that the masses of pollen seem to be enough for both genera to feed upon, as the young of both host and parasite were found living harmoniously together, and the hosts and their parasites were both discovered at the same time. *Nomada bisignata* (Fig. 89) as figured, was taken in Maryland.

Subfamily 3, *Longilabra*, of Westwood, is, as its name imports, distinguished by the oblong form of the upper lip. The genus *Cœliodes* is also a cuckoo, or guest bee, and lays its eggs in the nests or cells of other bees. Dr. Packard says the body is stout and the bee mimics its host. *Megachile.* The insects are found in flowers. *Melecta*, of Latraille, is said to be short and hirsute, and in Europe, according to Westwood, is parasitic in nests of *Anthidium*. *Megachile*, *Osmia*, *Anthophora*, and *Epeolus* are parasitic in *Colletes*. According to Dr. Packard, in the genus *Anthidium* the males are much smaller than the females, and the abdomen is broad and armed with lateral and terminal spines; the insects frequent woolly-leaved flowers, stripping off the down to form their nests, which they place in holes of trees, &c. They hibernate in the larva state, and the bees make their appearance in summer. *Anthidium manicatum* (Fig. 90), a European species, is figured here from Westwood.

Insects of the genus *Osmia* are commonly known by the name of mason-bees. Their habits are various. Some of them make cells in holes or in rotten palings and posts, others construct nests of minute grains of sand cemented together with a glutinous secretion, in angles of walls, or crevices between bricks. In Europe *Osmia gallarum* forms nests in abandoned oak-galls, around which it glues the leaves. *Osmia helicola* forms nests in deserted snail-shells, and others, *Osmia lignaria* of Say, were found in a perfect state in earthen cells beneath stones. Its cell was half an inch long, cylindrical, and contracted slightly into a sort of net just before the opening of the exit of the bee. The insect of *O. lignivora* (Fig. 91) is 0.50 in length, of a deep, blackish-blue color, with greenish reflections, and was tunneling in wood of elm, the tunnels being three inches in length by three-tenths in width, and which contained five somewhat jug-shaped cells.

The genus *Megachile* comprises the leaf-cutting bees, and are distinguished by their oval abdomen, and very short two-jointed maxillary palpi. The jaws and labrum are very large. These insects form nests in trunks of decayed trees, in holes of old palings and posts, &c., which are lined with pieces of leaves of a circular form, cut from plants and shrubs by their jaws, and curiously fitted together so as to form linings to their cells. The bottom of these cells being concave they fit into the mouth of the cells beneath; several of them are found in one burrow, fitting into each other like a nest of thimbles. One European bee uses pieces of the leaves of a scarlet poppy, others use leaves of roses or other plants. Some nests were found in old galls of *Callaspidia* (*Cynnis*) *confuenta* (Fig. 92) in Maryland. *Megachile centunculus* is a very common species, and forms its nests with circular leaves cut from rose-

bushes. *Megachile arcuata* (Fig. 93, two figures), is a somewhat common species, and is sometimes found in stems of elder. The nest of *Megachile brevis*, of Say, is also made of rose-leaves, and is scarcely different from *M. centunculus*. *Megachile* is destroyed by minute Ichneumon flies, *Arthophorcbia megachilis*.

The genus *Ceratina* in habits and structural characters closely resembles *Xylocopa* mentioned below. Their nests are formed in the pith of brambles and briars out of which they scoop the pith, and deposit in them at regular distances masses of a coarse sort of honey on which the larva feeds. Other authors, however, have asserted (erroneously) that they are parasites in nests of *Osmia*, &c. *Ceratina duplex* (Fig. 94) is a small, bright-green, smooth-bodied species, which burrows out the stems of alder, blackberry, syringa, aster, &c., or other pithy shrubs and plants, excavating them frequently to the depth of six or seven inches. It takes about two months for the insect to complete its metamorphosis to the perfect bee, which lives through the winter.

The fourth subfamily of Westwood, *Scopulipedes*, derives its name from the thick lining of hairs upon the hind legs of the female, and which constitute the pollen-brushes; they have no pollen-plates, and the abdomen is destitute of pollen-brushes. The sexes are often very different both in structure and color. The males in some having very long antennæ, in others the posterior tibiæ are thickened, while in a few the tarsi of the intermediate legs are furnished with curious brushes of hair. Their nests are formed in the crevices of old walls and in the ground on sunny banks; their cells are made of earth, and very smooth on the inside, and when finished the mouth of the nest is filled with earth. Males of the genus *Eucera* are distinguished by the great length of their antennæ (hence their name), which are nearly the length of the body. The cells of the European species are formed under ground at a depth of two or three inches, and their internal structure is very smooth.

Eucera maculata is a common species here, and they are said to be gregarious in habits, their nests being placed near each other. The genus *Anthopliora* resembles *Bombus* or the bumble-bee in its plump and hairy body. They are also gregarious, their numerous cells, although independent of each other, being crowded together in grassy banks. The insects themselves are troubled with parasites; a species of *Melecta* lays its eggs in their cells, and their larvæ are infested with flies of a *Chalicis*, *Antherophorabia*, and *Monodontomerus*, and a peculiar kind of mite, *Heteropus ventuicous*, according to Dr. Packard. The European species, *A. vetusa*, makes its nest in hard, dry banks, and in crevices of walls, burrowing through the mortar, and causing much damage by loosening the bricks.

The genus *Xylocopa*, or the tree-carpenter bees, contains some very large species. *Xylocopa* of Europe, by means of its jaws, burrows in the wood of posts, palings, &c., and forms passages twelve or fifteen inches in length, of rather more than half an inch in diameter; the top and bottom of the tunnel are curved, having a passage at each end. When the burrow is complete the bee deposits an egg at the bottom, with a proper supply of pollen-paste, and the whole is then covered with a layer of agglutinated sawdust, formed during the construction of the burrow. The layer thus formed serves not only as the roof of one cell, but as the floor of another, which is placed immediately above it. They thus proceed until about a dozen cells are formed. When the larvæ are full grown they assume the pupa state, head downwards, so as to allow the lowermost and eldest to make its way out of the bottom of the burrow, as soon as it becomes winged, and which in consequence takes place earlier than in those which occupy the upper cells.

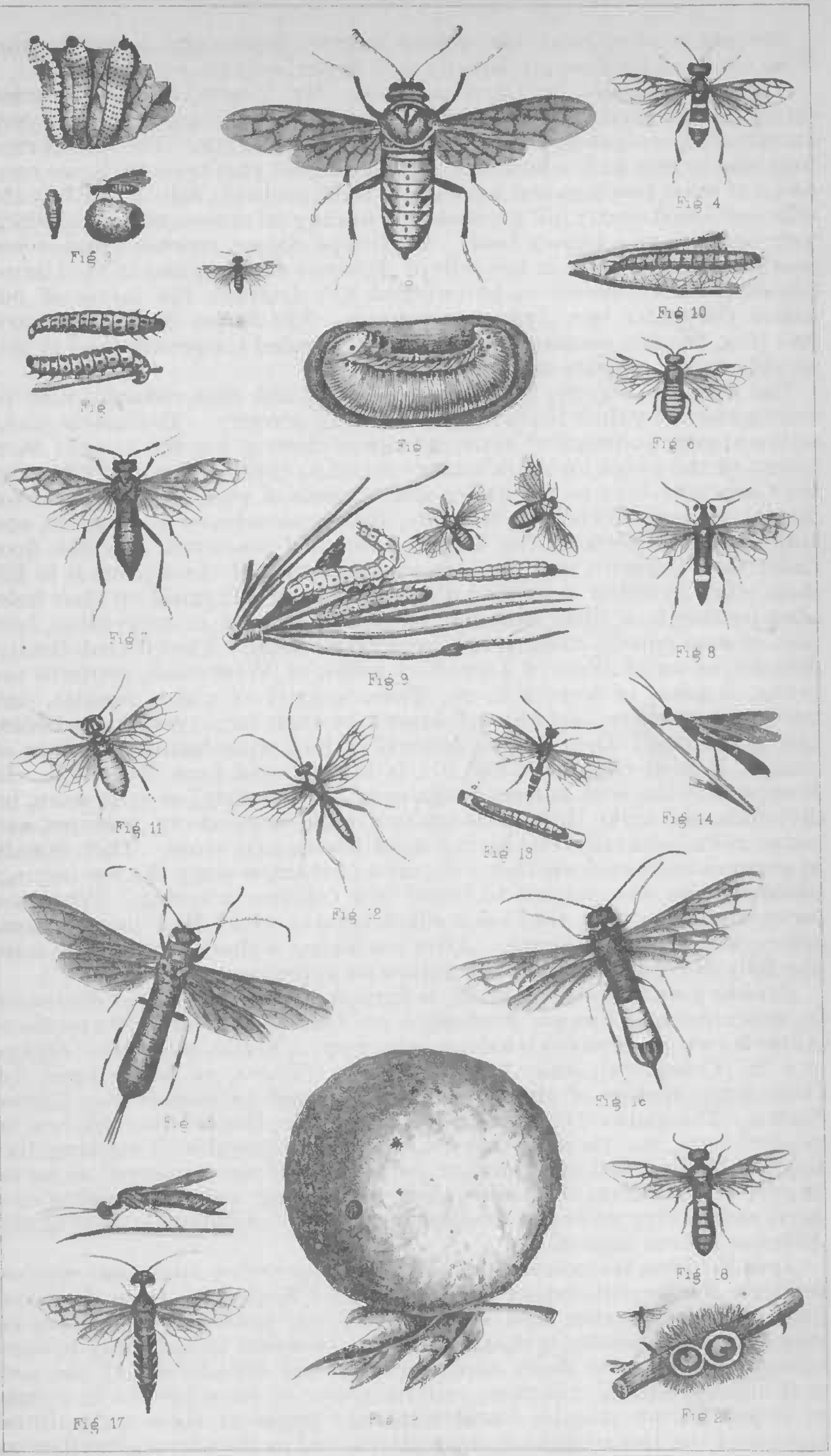
The above very lucid and comprehensive description is taken from Westwood, and will apply equally well to our well-known species.

Xylocopa virginica, or Carpenter bee. Mr. Angus, of West Farms, states that in making its burrow the bee follows the grain of the wood, except at the entrance, which is about her own length. The tunnel runs from one to one and a half feet in length; the partitions in it are composed of wood-raspings and some sticky fluid, probably saliva. In July the cells contained nearly full-grown larvæ feeding on masses of pollen, which were as large as a kidney bean. In Europe *Sapyga repando* (*Hymenopterous insect*) is parasitic in the cells of *Xylocopa violacea*, and in the United States *Anthrax simoso* (a two-winged fly) destroys the larvæ of our native Carpenter bee, *Xylocopa virginica*. The males of *Xylocopa carolina* (Fig. 95) are usually known as white-headed Carpenter bees in this neighborhood, and are said not to sting.

The females (Fig. 96, insect, natural size, and nest reduced) may be distinguished by their black heads, and sting severely. The insects themselves appear to frequent some species of flowers for the sake of their honey, or the sweet liquid substance found in them. The injury done by the Carpenter bees to the under side of roofs of piazzas, or under ornamental railing of wood or to posts, &c., is sometimes very great, and may readily be seen by the heaps of sawdust scattered over the floor under their burrows, and the best way to get rid of these pests is to kill them when entering or leaving their burrow, or plugging up their hole, after putting in a little camphor, or cotton steeped in turpentine, benzine, or some equally disagreeably-scented material. The fifth sub-family, *Sociales*, or social bees, of Latraille (*Apidea* of Westwood), contains the genus *Bombus*, or humble-bees. These consist of males, females, and neuters or workers, and are well-known by their large, very hairy bodies and great size. Their colors, generally black with bands of yellow or orange, *Bombus virginicus* (Fig. 97), is here figured from Maryland. In Europe they are said to form societies of fifty to sixty, or even more, individuals, and make their nests under ground in meadows, pastures, and hedge rows, generally employing dead leaves and moss. They remain in societies until cold weather kills most of them, leaving the few impregnated females who survive to found new colonies in spring. When the larvæ are fully grown they open silken cells in which they inclose themselves, and change to pupæ. After remaining a short time in this state the fully-developed humble-bee makes its appearance.

Bombus pennsylvanicus (Fig. 98) is figured. These insects are destroyed by *volucellus* and *Conops*, *Authomyia* or *Tachina*, and several species of *Anthras* (see in *Diptera*) *Anobium paniceum*, a beetle, *meloe* and *Slylops* (see in *Coleoptera*), and *Antherophagus* a *Chalcis*, or four-winged fly. Over forty species of the humble-bee are said to inhabit the United States. The genus *Apthus* is said to resemble *Bombus* (humble-bee) in general form, but these insects are said to be incapable of working like the humble bee, and are therefore parasitic, and are supported as larvæ to prey on the larvæ of *Bombus*, their tibiæ being convex instead of concave, and having no organ for carrying pollen. *Apathus elatus* (Fig. 99) *Fabricus* is here figured.

Apis Mellifica, the common hive bee, and some other analogous species, formerly the second section of the Socials of Westwood, have the basal joint of the posterior tarsi striated, and the posterior tibiæ have no spurs at the extremity, a character not to be found in any other hymenopterous group. So many comprehensive and full details of the natural history, habits, structure, and treatment of these insects in a state of domestication may be found in former pages of these agricultural reports of the Department of Agriculture, and in the various treatises on



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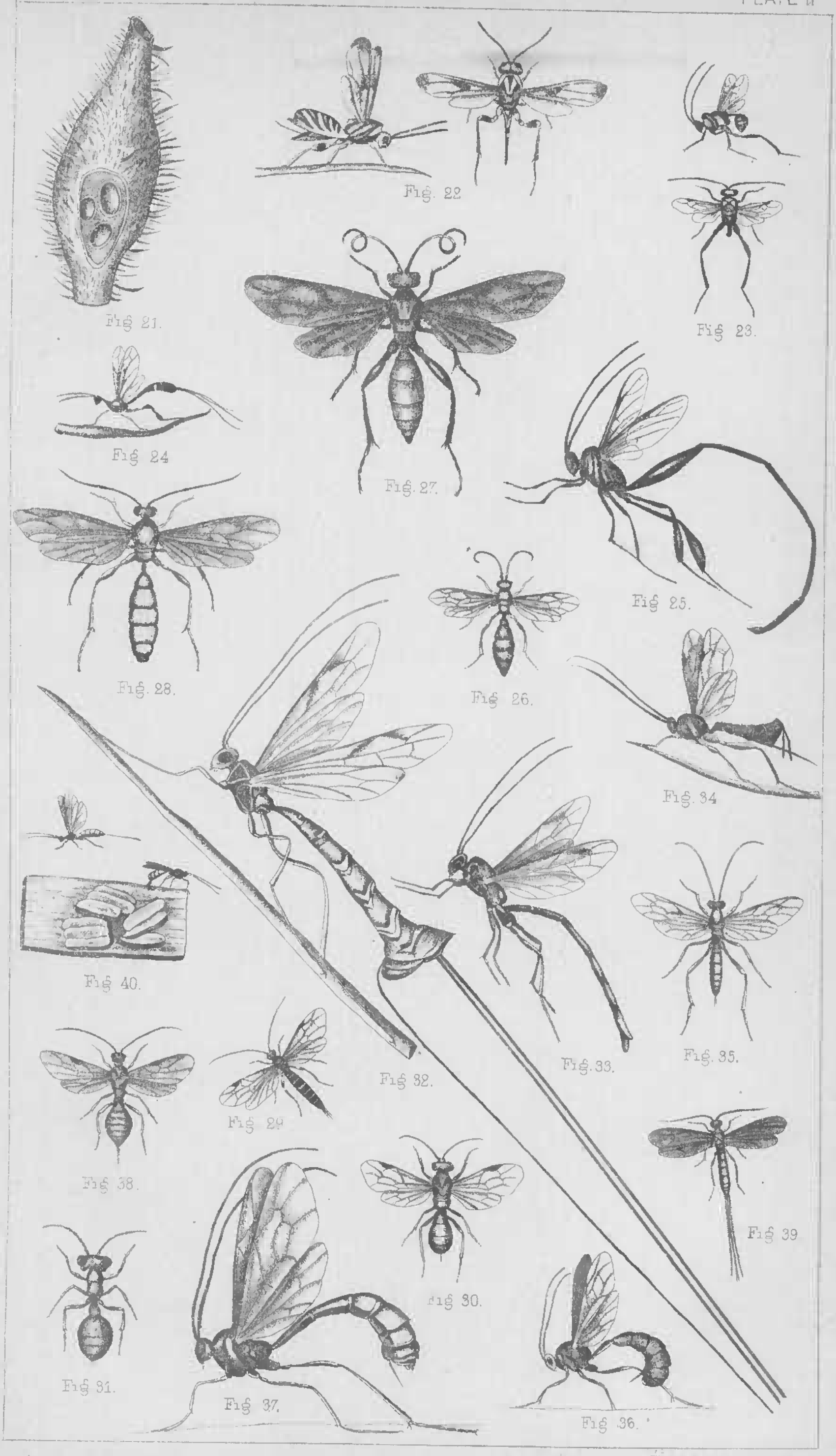

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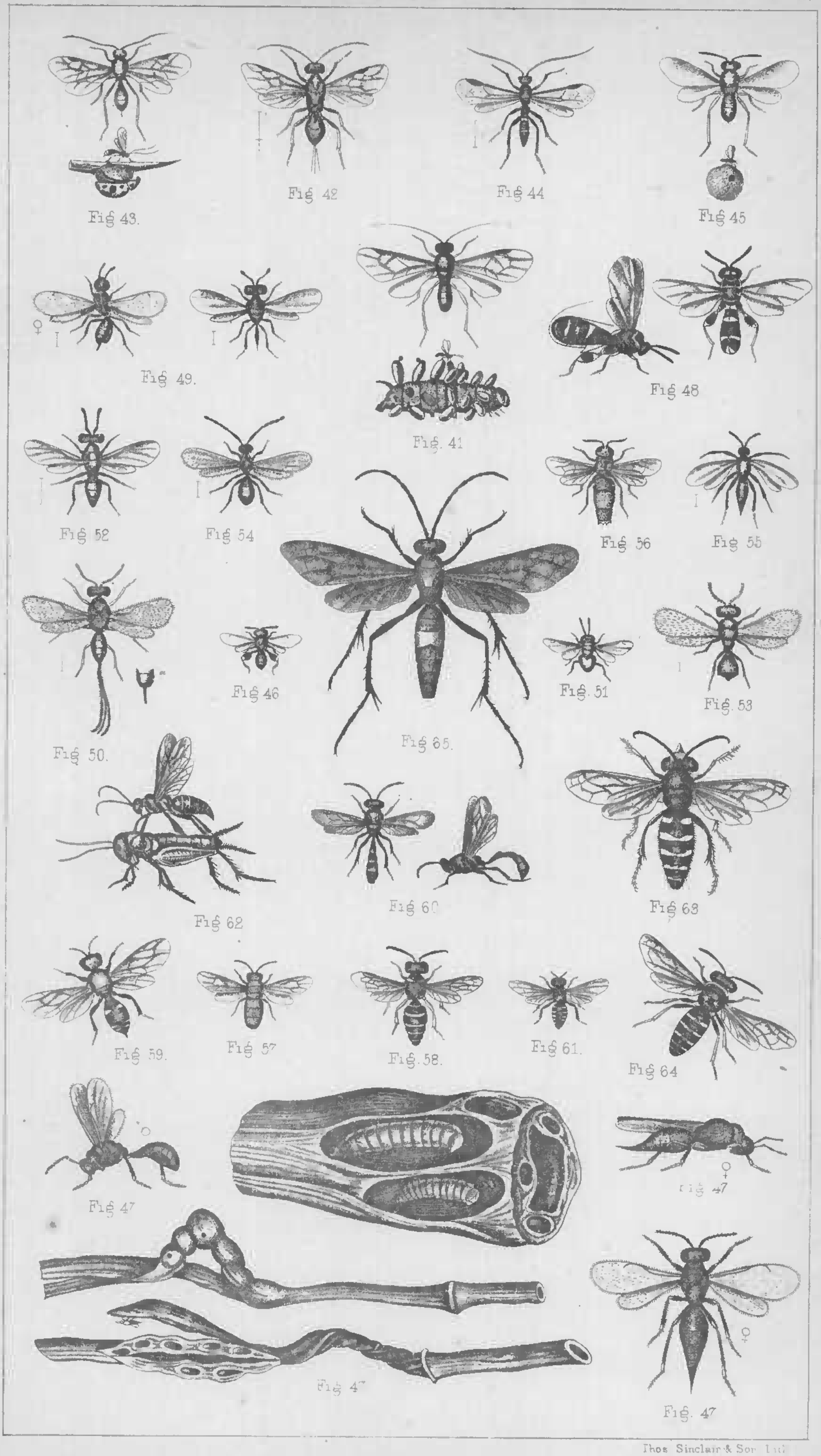

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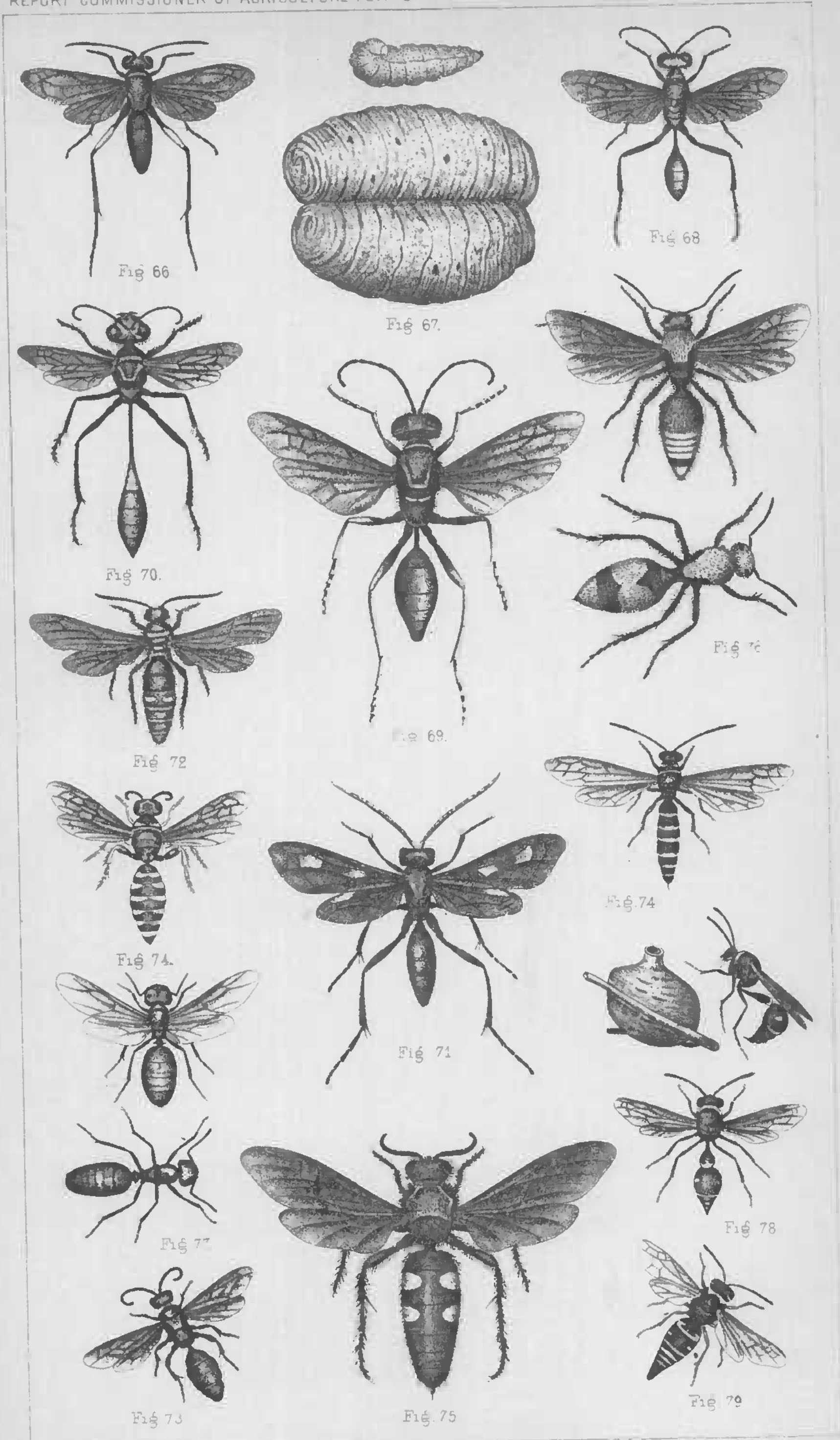

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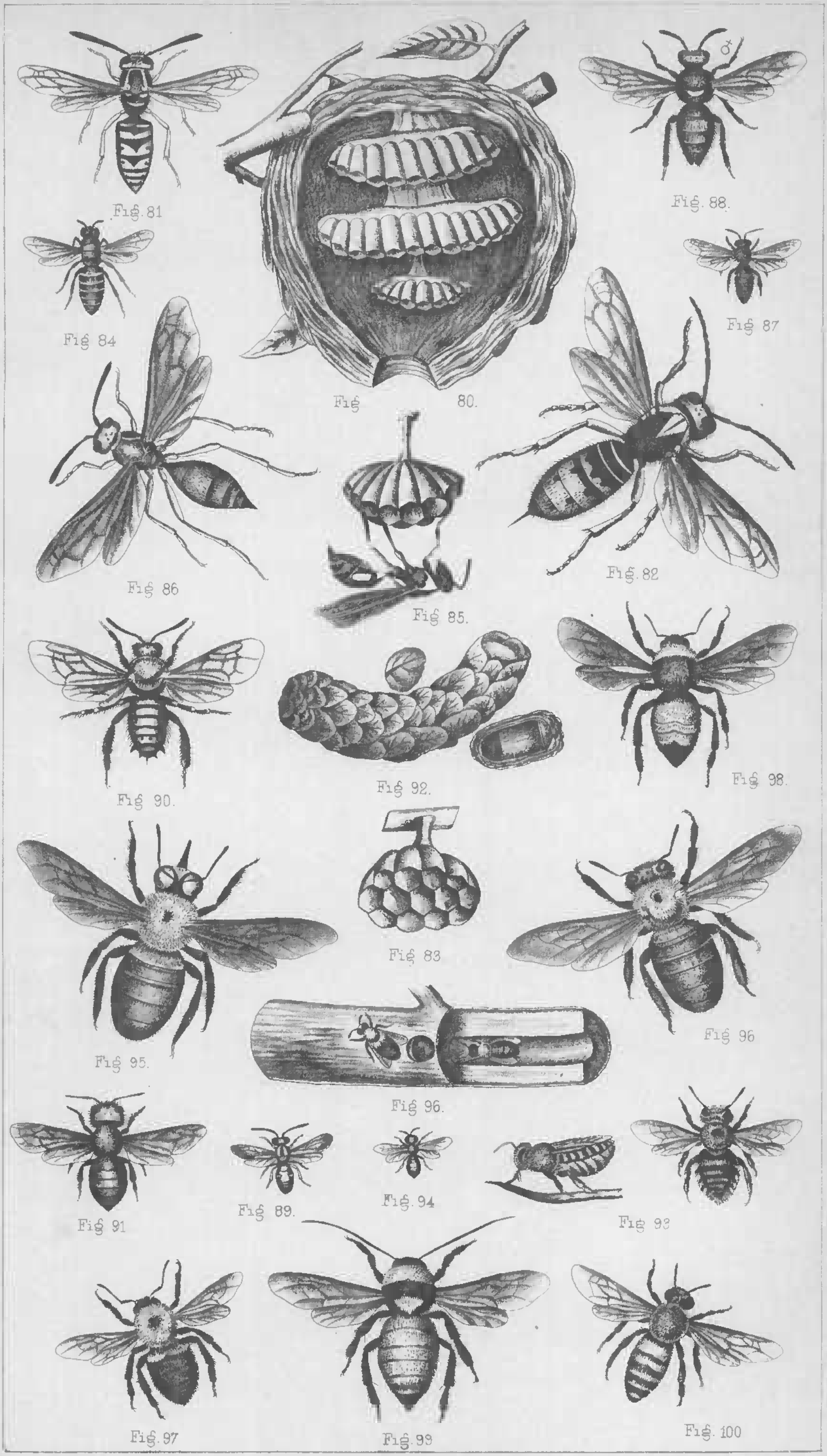

Thos Sinclair & Son, Lith

the bee and its culture, that it will be useless, and take up too much space, to recapitulate them here. We will therefore merely add a few notes on the subject, and give a list of the varieties of Honey bees that are domesticated or raised in the various countries, from Westwood.

Apis mellifica is our common honey bee from Europe and imported into the United States. *A. ligustica* is kept in some parts of Italy; *A. fasciata* in Egypt and some parts of Asia Minor; *A. unicolor* in Madagascar; *A. indica* in Bengal; *A. adansonii* in Senegal; and an undescribed species is known in Chili. *Apis lingustica* (Fig. 100), the second bee mentioned in this list, is said to agree with the description of the honey bee in Aristotle.

These bees have been introduced into the United States, and when kept pure and unmixed with our common honey bee are said to be milder in their temper and more diligent in laying up honey. They may be distinguished by their color and by having a broad orange ring or mark on their abdomen.

Not having a specimen we have taken our figure from the naturalist's library. The common honey bee is destroyed by several parasites, among which will be found *Phora incrasiatu*, or bee fly; *Braula caeca*, or bee louse; *Trichodes*, a beetle; *Clerus apiarius*, &c., of Europe, also a beetle; *Melöe* and *Slylops*, both coleopterous insects; and a gordius or hair snake or worm. The bee moth (*Galleria cereana*), however, is one of the greatest troubles to the bee keeper, as their large, yellowish-white, clumpy larvæ or grubs eat through the wax cells in the hive and spin their filthy webs throughout the comb, and thus cause the bees to desert the hive. There are several patent hives which are said to be moth-proof, and which are highly recommended by the patentees and others, but in this case the department can recommend no particular hive, but leave the subject entirely to the apiarians themselves to decide which is the best and most reliable. Some years ago we ourselves cleared a hive of the bee moth by merely laying three or four hollow pieces of elder, split lengthwise down the middle and notched here and there at the sides, making holes into which the worms retreated in the night when fallen from the comb on to the foot-board of the hive on which the bee-traps were placed. These sticks were withdrawn very early every morning and examined, the grubs killed, and the sticks replaced immediately.

On the first few days after applying these traps on the foot-board of the hive, at least 10 to 15 worms were taken daily until at last they dwindled down to only 3 or 4; finally these troublesome pests were destroyed. At the same time, however, the hive was examined, and all the perfect moths found were immediately killed, and the wrens were encouraged to build close to the hives to destroy the insects and fallen worms on the ground. The elder sticks were only used before the introduction of the numerous patented hives and other devices which have of late been used.

A hive of stingless bees was once sent to the departmental gardens from South America, in a hollow tree or log, but, although they lived and worked a little during the heat of summer, all died during the first cold weather. Their comb was of a very dark, coarse, and somewhat brittle wax, with irregular large cells, from the size of a sparrow's egg to that of a pigeon. Westwood speaks of other exotic species composing the two genera, *Malépora* and *Trigona*, and says that insects of the latter genus build their nests at the top branches of trees, out of the reach of monkeys, in the shape of a large pear, while the former select cavities in rotten stumps of trees.

REPORT OF MUSEUM DIVISION.

Since the last report of this division was made, the entire museum has been thoroughly renovated. The large accumulation of material during the last two years necessitated additional space for purposes of exposition, and as the floor-space was fully occupied with cases, a gallery was decided upon. Plans were therefore drawn up by the architect of the building, and, upon the appropriation of $2,500 by Congress, the gallery was constructed, occupying two sides of the museum hall. The requisite number of cases to fill such a gallery were already in the possession of the department, the museum cases used for the Centennial exhibit having been planned with this object in view, and at the close of the Exhibition in Philadelphia were transported to Washington, and, in July and August, were placed in position.

The galleries extend on the north and south sides of the museum hall and are 15 feet in width, that on the north extending 102 feet, or the entire length of the museum. On the south side the vestibule of the museum-entrance divides the gallery into two sections, each 41 feet long, making an additional floor-space of 2,760 feet, or a total space, in round numbers, of 6,500 feet in the museum hall, without allowing for three staircases. The gallery is 13 feet high from the main floor of the museum to the top of the iron supports; to the floor of the gallery is another foot, leaving a space of 13 feet between it and the ceiling of the museum. The cases on the main floor, sixteen in number, reaching to the gallery, project beyond it into the center of the hall 3 feet; they are 14 feet long and 4 feet wide, and are arranged with three stationary shelves. The new cases placed immediately over them are much lighter in construction and of the same width, but in length are only 10 and in height but 8 feet. "Patent adjustable shelving" is used in these cases, together with improved graduated steps, made after designs furnished by one of the museum-assistants.

In the center of the hall, opposite the main entrace, is placed the large red-wood table surmounted by a single California plank, and on either side of it, running lengthwise up and down the hall, are four low cases, making in all forty cases for the purposes of exhibition. All the shelving and interior iron work has been repainted a bluish tint, contrasting better with the specimens than the dead white formerly used. Upon the completion of this work the department collections exhibited at the Centennial were unpacked and, with the old museum collections, arranged principally in the lower portion of the hall. Such of the specimens in the large collection of foreign donations secured at the Centennial as were already in jars, or in condition to exhibit, were brought into the museum, though fully one-half of this collection still remains unpacked. Four cases in the southeast gallery are used for the exhibition of native and foreign woods, and for objects of strictly botanical interest.

The collection embraces, first, the direct products of American agriculture, as the grains, fruits, and fibers, as produced by the farmer, with only the simple preparation necessary to market them; then the indirect products of the soil, where are exhibited the same objects after having passed through one or more stages of preparation, as the fiber spun into thread and woven into fabrics, or the grains and fruits or other vegetable products changed by chemistry or the arts into food preparations or materials used in the economic arts. A section of the museum is devoted to objects in the animal kingdom useful or injurious to agriculture, or entering into the economy of the farm, as domestic animals, poultry,

game, and small birds, or the insects injurious to vegetation, comprising the natural history of agriculture.

In arranging such a collection, a classification must be adopted that is simple and at the same time comprehensive, and as it is one of the objects of an agricultural museum to give the consecutive history of a product, showing it in its various stages, as, for example, cotton from the seed to the manufactured fabric, the raw material and the prepared substance must be exhibited in close proximity. As the collection of cereal products is of the first consideration, to be of real value a large series is necessary in order that proper comparisons may be made, and as many varieties are only suited to particular sections of the country, the arrangement is necessarily by States. Thus we are enabled to trace a given wheat or barley through different portions of the country, and, rating weight and yield, to mark that State or group of States where it seems to thrive best. With foreign collections, an arrangement by countries shows at a glance the agriculture of a particular country and the comparative agriculture of different countries in relation to each other. After the collection of bread-producing substances come the fruits and vegetables, and these are arranged in a somewhat similar manner; then follow the manufacture from all of these in their varied forms, as flour, starch, sugar, &c., together with various other vegetable substances and their preparations, the whole grouped in one section as substances used for food.

The materials used exclusively in the economic arts or in manufacture, as the textile fibers, paper-making materials, coloring and tanning substances, oils, gums, resins, &c., and the objects made from them, including also a few substances closely related from the animal and mineral kingdoms, are grouped in other sections. Here we are enabled to show comparatively, the products of different sections of the country or of the world as used in the mechanic arts, and to trace them step by step through all their changes, showing the farmer or the general observer just what portions of a plant, or what kind and quality of wool, enters into the construction of a particular fabric.

In a third section are grouped the animals, birds, and insects, showing the true types of domestic poultry and their supposed origin; our game birds that have been or may be domesticated or introduced from other countries, the small birds arranged in their relation to agriculture as to their benefit or injury; and lastly the grand army of noxious or beneficial insects.

A fourth group illustrates practical botany by collections of native and foreign forest-woods, &c., carpological collections, and specimens of fibers, fruits, seeds, &c., of strictly botanical interest; and into a fifth section are grouped fertilizers, soils, farm implements, and miscellaneous objects that can have no place in the foregoing sections.

A museum of this character should be for utility, and not for mere exhibition as a free show-room. In the first place, it is an object library, where, consulted in connection with the conservatories or arboretum, questions may be at once answered upon the entire history of most of our vegetable products. Nor is the mere labor of arranging the specimens in cases the principal work of the museum. The history, description, uses, and methods of preparation of its many interesting products should be gleaned, new facts added, study and examination made—with the microscope where necessary—and this valuable information given to the public in a form that will enable those who never visit the department to avail themselves of the benefits of its collections. In addition, there are new and interesting fibers that may be utilized, gums and

resins that may contain some unknown useful element to be examined and tested, and many other products that in a mere exhibition-room might lie upon a shelf a meaningless object for ages; and only such putting the museum into imperishable record will bring out this *knowledge* and make it truly useful, or answer the ends for which it was established.

The following is a systematic classification of the museum, from a study of the museum itself, and relating only to the material it at present contains:

ECONOMIC MUSEUM OF AGRICULTURE.

Systematic classification.

Section A.—Food substances.

SUBSECTION I.—CEREALS AND LEGUMES.

a. Cereals.

Wheat, maize or Indian corn, rye, barley, oats, buckwheat, and rice, native and foreign.

(These and the following specimens in this subsection are arranged by States or by countries.)

b. Small grains and seeds.

Millet, sorghum, &c.

(The grass-seeds are also included in this subsection.)

c. Legumes.

Beans, pease, &c.

SUBSECTION II.—FRUITS AND VEGETABLES.

a. Without preparation.

Models in plaster, papier-maché, &c.

Preserved as specimens in alcohol, brine, &c.

b. Prepared for food.

Edible nuts, as almond, walnut, pecan, &c.

Dried fruits—apples, peaches, &c., figs, raisins, &c.

Canned fruits.

Preserves.

SUBSECTION III.—FARINACEOUS SUBSTANCES.

a. Grits.

Cracked corn and hominy, cracked and crushed wheats.

Avena or oaten grits, farina (Hecker's), &c.

Pearl barley.

b. Meals.

White and yellow meals from Indian corn.

Rye, Graham and oat meal.

Meal of plantain, cassava, &c.

c. Flour.

Wheat, rye, and buckwheat flours.

Rice-flour.

Flour from dried tubers of sweet potato.

d. Starches.

A.—USED AS FOOD.

Corn-starch, maizena, and other cereal starches.

Starch from cassava, farina from bread-fruit.

Arrowroot, sago, tapioca, mandioca, &c.

B.—USED IN THE ARTS (placed provisionally in Section A).

Potato, wheat, and other starches used for sizing; dextrine.

e. Miscellaneous.
Complete series illustrating the manufacture of flour.
Split pease, dried sweet corn, &c.
Bread made by natives of Santo Domingo, and other specimens.

SUBSECTION IV.—SUGAR AND SIRUPS.

a. Sugar-cane.
Raw and refined sugars, native and foreign.
Molasses, sirups, drips, &c.
b. Sorghum.
Raw and partially refined sugars from Northwestern States.
Sirups.
c. Beet-root.
Models of the sugar-beet.
Dried sliced root, first stage of manufacture.
Crystals, loaf and granulated sugars, native and foreign.
d. Maple.
Cakes and granulated sugars.
Syrup.
e. Miscellaneous.
Sugar manufactured from corn-stalks.
Sugar of milk.
Glucose.

SUBSECTION V.—BEVERAGES, LIQUORS, AND NARCOTICS.

a. Tea.
Varieties of leaf-tea from Japan and China.
Substitutes for tea (Japanese) and probable adulterations.
Maté or Paraguay tea.
Cocoa (*Erythroxylon*).
b. Coffee.
In berry, various countries.
Preparations.
Substitutes and adulterations (chicory, &c.).
c. Cocoa.
Cocoa beans and seed-pod, or envelope.
Cocoa "shells."
Preparations—cocoa, broma, chocolate, &c.
Sweetened chocolates are also included here.
d. Vinegar and wines, or products of fermentation.
e. Liquors produced by distillation.
(Groups *d* and *e* not represented at present.)
f. Narcotic stimulants.
Tobacco:
Native and foreign leaf-tobacco.
Prepared leaf for chewing and smoking; snuff.
Opium, when used as a stimulant.

SUBSECTION VI.—SPICES, CONDIMENTS, &C.

a. Spices.
Nutmeg and mace, cloves, cinnamon, allspice, ginger, cayenne and black pepper.
b. Aromatic seeds.
Anise, caraway, coriander, cardamom, &c.

c. Substances for flavoring, pot-herbs, &c.
Vanilla bean, &c.
Sage, marjoram, thyme, basil, mint, tansy, &c.
d. Table oils, vegetable sauces, &c.
Olive oil and its substitutes (peanut oil).
Japanese soy and other sauces.
Catsups and prepared horse-radish.

SUBSECTION VII.—ABORIGINAL FOOD SUBSTANCES.

a. Cereals and seeds. (Natural state and prepared.)
Maize, native varieties; wafer bread from blue corn.
Wheat and other cereals, grass seeds.
Mesquite and screw beans, natural state, pounded into coarse meal, made into bread.
b. Nuts, dried fruits, &c.
Piñon, acorns, &c.
Berries, dried or pressed into cakes.
Grapes and stone fruits.
Fruits of cactus and yucca, dried and preserved.
Muskmelon, pumpkin, &c., dried in strips.
c. Roots, leaves, &c.
Kouse root, tubers, sliced and dried, bread or cakes.
Kamas root, tubers, rude cakes.
Wild potatoes (*Solanum*).
Leaves (inside) of Agave, roasted and preserved.
Hops, sugar from Labba cane (Mexican).
Liquor distilled from Agave, "Mescall."
d. Miscellaneous substances (not vegetable).
Jerked beef.
Insects, dried and prepared.
Eggs of fish or animals, dried.
Blue clay (containing magnesia), eaten with potatoes.

Section B.—Substances used in the Arts and Manufactures.

SUBSECTION I.—TEXTILE FIBRES.

A.—ANIMAL FIBERS.

a. Wool from sheep.
Wool clips, washed and unwashed.
Fine wools. (Principally used for clothing.)
Long wools. (Principally used for worsteds.)
Coarse wools. (Used in carpet manufacture.)
Manufactures:
Dyed fleece. (Sometimes used as trimmings.)
Spun-wool, yarns, and worsteds.
Flannels and piece goods, shawl manufacture.
Feltings, including druggets.
Rude manufacture of aborigines, blankets.
Miscellaneous objects.
b. Wool from goats.
Angora or Cashmere, fleece and fabrics.
Rocky Mountain goat, fleece.
c. Hair from various animals.
Camel, llama, and fine hair.
Cow and calf hair.

d. Silk.

Bombyx mori, native and foreign:
- Cocoons, mulberry and osage-orange fed.
- Reeled silk.
- Manufactures.
  - Spun and dyed, for embroideries and weaving.
  - Fabrics, including jacquard weaving.
  - Silk-gut and miscellaneous manufactures.

Foreign silk-producing insects (other than *B. mori*):
- *Bombyx pernyi*, cocoons, reeled silk, and fabric.
- *Bombyx yama-mai*, cocoons, and reeled silk.
- *Bombyx mylitta*, cocoons and silk.
- *Bombyx cynthia*, cocoons, silk and fabric.
- Miscellaneous.

Native silk-producing insects:
- *Samia cecropia*, cocoons, silk, and silk-gut.
- *Telea polyphemus*, cocoons.
- *Tropæa luna*, cocoons.
- *Platysamia promethia*, cocoons.
- *Bombyx cynthia* (introduced), cocoons.
- Miscellaneous.

Silk produced by other insects and by spiders:
- Ichneumon silk.
- Silk made by various spiders, as *Nephila plumipes.*

B.—VEGETABLE FIBERS.

I. *Fibers suitable for spinning and manufacturing purposes.*

a. Cotton.

Lint cotton, (including seed-cotton and cotton bolls):
- Long staple or sea-island.
- Short staple or upland.
- Tree cotton, or perennial.

Manufactures:
- Miniature bales, as baled for market.
- Cleaned, carded, and spun (10 processes).
- Fabrics, including spool-cotton.
- Home production (100 years ago) and rude manufactures.

b. Flax.

Raw.

Raw or partially prepared:

Flax-straw, rotted and broken, tow and line.

Manufactures:
- Various processes of manufactured linen goods, &c.
- Flax-cotton fiber and fabrics.
- Flax-wool fiber in stages of preparation.

c. Ramie.

Specimens of plants showing leaves; stalks as grown.

Raw fiber, as stripped from stalks, partially prepared.

Various stages of manufacture.

Fabrics composed wholly of ramie, or mixed with other fibers.

II. *Fibers suitable for spinning and manufacturing purposes, but of inferior durability or coarser texture.*

d. Jute.

Jute in raw state, jute butts, &c.

Prepared fiber and manufactures.

Gunny-bags, carpets, crash, tapestry, &c.

e. Malvaceous fibers.

Raw and prepared fiber of *Hibiscus esculenta, H. subdariffa, H. sinensis*, &c.

Stalks and fiber of *Abutilon avicennæ.*

f. Miscellaneous fibers (prepared experimentally).

Asclepias, stalks, fiber, fabric (one-half cotton.)

Epilobium, fiber and manufacture.

Pinus sylvestris, or vegetable flannel.

III. *Fibers chiefly used in the manufacture of cordage, twine, &c., but sometimes woven or beaten into cloth, or used for miscellaneous purposes.*

g. Foliaceous fibers.

New Zealand flax, *Phormium tenax:*

Leaves and partially prepared fiber.

Manufactures, as rope, twine, nets, matting, and cloth.

Agave or aloe fibers:

Agave sisalana, Sisal hemp, leaves, fiber.

Specimens of Fayal lace-work.

Agave Americana, fiber, mats, brushes, &c.

Fourcroya cubensis, leaves and fiber.

Manila hemp:

Leaves, raw and prepared fiber of *Musa textilis.*

Screw-pine:

Fiber of *Pandanus odoratissimus.*

Pine-apple:

Leaves and prepared fiber of *Ananassa sativa.*

Yucca:

Raw and prepared fiber, rope and paper from *Yucca gloriosa, angustifolia*, &c.

Corn-husks:

Husks, fiber, crash, oil cloths, and paper.

h. Miscellaneous coarser bark fibers.

Hemp:

Raw and prepared fiber, rope and cordage.

Apocynum:

Stalks, raw and prepared fiber of *Apocynum cannabinum.*

Mats, bags, baskets, nets, &c., made by Indians.

i. Lace barks and tapa.

Brousonetia papyrifera, tapa cloths, &c.

Bark of *Daphne tenuifolia, Lagetta lenteria*, &c.

Leaves of *Celmesia coriacea.*

IV. *Fibers suitable for the manufacture of very coarse cordage, mats, or for upholstering purposes, including silk-cottons.*

j. Coarse fibers, various uses.

Coir, or cocoa-nut fiber, raw and prepared; spathe; "hats," mats, matting, rope, brushes, and imitation hair for upholstering.

Attalea funifera, fiber used for brushes and brooms.

Xylopia sericea, made into rope for tying cattle.

k. Fibers for stuffing or upholstering only.

Southern moss, *Tilandsia usenoides*, "hair."

Pulu, *Cibotium menziesei*, a fiber from the tree fern, known as "pillow-wool."

l. Silk-cottons or "downs."

Bombax (species), pods and "silk."

Asclepias, pods and down; "vegetable silk."

"Down" from poplar tree.

V. *Miscellaneous substances,* not strictly fibrous, when manufactured, plaited, or coarsely woven into hats, sacks, baskets, &c.*

m. Grasses and reeds.
Tule, used as cases for wine-bottles.

n. Palm leaves.
Split leaves of fan-palm, made into sacks and mats.

o. Cane and bamboo.
Split bamboo, baskets, fans, &c.

SUBSECTION II.—PAPER MATERIALS.

a. Writing and printing papers.
Pure rag (cotton and linen):
American linen, cotton and linen rags, pulp, and papers.
Flat papers, cotton rags, pulp, paper.
Rag and paper:
Flat paper, colored rags, and waste paper, pulp, and manufacture.
Book and news, colored rags and paper, pulp, papers.
Cover papers, the same.
Wood:
Maple wood and sample of printing-paper.
Esparto:
Fine printing-papers, grass, pulp, and paper.
Maguey:
Drawing-paper from leaves of agave.
Palmetto:
Printing-paper, leaves and paper samples.
Okra:
Printing-paper (coarse); stalks, pulp, news paper.
Husk:
Various papers; corn-husk, pulp, and manufacture.

b. Wrapping and coarse papers.
Manila:
All-rope; complete stages of manufacture, flour-bags.
Manila wrapping; old rope, gunny-sacks, and waste paper, pulp, manufacture.
Bogus manila; gunny-sacks, waste paper, straw pulp, paper.
Straw and grass:
Straw-wrapping; straw, pulp, paper in variety.
Spartina grass (*S. cynosuroides*); grass and paper.
Hay, sample of paper.
Yucca (*Yucca angustifolia*):
Stalks of yucca, various samples of paper.
Cane:
Canebrake, fiber and paper.
Sorghum, sample of paper.

c. Miscellaneous substances capable of manufacture.
In this division are included those fiber-producing plants from which paper has been made, but not generally used as paper materials in this country; includes paper from ramie.

d. Chinese and Japanese papers.
Mulberry, bamboo, and straw papers.
Fancy papers for screens, &c.
Imitation leather.
Rice paper, *Aralia papyrifera*.

* A considerable collection of fibers belonging to this group have yet to be identified and placed in the collection, used for making hats, twisted ropes, &c.

SUBSECTION III.—DYES AND COLORING MATERIALS.

a. *Vegetable origin.*
Roots:
Madder, tumeric, &c.
Woods, bark, and leaves:
Indigo, fustic, logwood, quercitron, &c.
Flowers, seeds, or fruit:
Saffron, arnotto, &c.
Lichens:
Species of roccella.
b. *Animal origin.*
Cochineal insect (*Coccus cacti.*)
Chermes, &c.
c. *Mineral origin.*
Aniline dyes and coal-tar products, &c.

SUBSECTION IV.—TANNING MATERIALS.

d. *Barks, leaves, galls, whole plants, woods, &c.*
As much material that would be classed in this subsection remains unpacked at the present time, its place is merely indicated, without attempt at classification.

SUBSECTION V.—GUMS AND RESINS.

a. *Gums.*
Mucilaginous gums, as tragacanth, acacia, dragon's blood, &c.
b. *Oleo resins.*
Copaiva, various balsams, "black varnish," camphor, &c.
c. *Gum resins.*
Assafetida, ammonia comp. myrrh, &c.
d. *Resins.*
Pine resins, mastic, dammar, burgundy pitch, &c.
e. *Lacs.*
Various resins produced by punctures of insects.
f. *Elastic gums.*
Caoutchouc or India rubber, gutta-percha, balata.
Manufactures from same.

SUBSECTION VI.—FATS, OILS, WAX, &C.

A.—VEGETABLE ORIGIN.

a. *Vegetable tallow and wax.*
b. *Fixed oils.*
Linseed, cotton-seed, castor-bean, croton oil, &c.
Almond, walnut, olive, and palm oil, &c.
Manufactures from above, soaps, &c.
c. *Essential oils.*
Oil of hemlock, wintergreen, peppermint, sassafras, bergamot, pennyroyal, &c.

B.—ANIMAL ORIGIN.

d. *The animal fats and oils.*
e. *Beeswax.*
Soap, candles, and various manufactures.

C.—MINERAL OILS, &C.

e. *Petroleums and coal-oils.*
f. *Bitumen.*

Section C.—Natural History in Relation to Agriculture.

SUBSECTION I.—ANIMALS.

a. *Domestic animals.*
Stuffed types of farm animals (none at present in the museum).
b. *Animals found upon the farm in wild state.*
Those animals denominated as "farm pests," or those useful by destroying insects, or as furnishing food. Among those may be named rabbits, foxes, mice, squirrels, skunks, &c.

SUBSECTION II.—BIRDS.

a. *Domestic poultry.*
Types of various breeds of chickens, ducks, geese, turkeys, &c., together with pigeons.
b. *Game birds.*
Fowls, showing origin of domestic poultry.
Hybrids.
Game birds of the United States.
Foreign game birds that have been or may be introduced, pheasants, &c.
c. *Birds—beneficial or injurious.*
Small birds shown with contents of the stomach.
(The end of each perch is colored white or black to show the proposed proportions of benefit or injury.)
Owls and rapacious birds.

SUBSECTION III.—INSECTS.*

a. *Economic collections.*
Native insects injurious to vegetation, arranged in regard to the plants on which they feed, showing various stages and parasites, together with artificial means of destruction.
b. *Scientific collection.*
Native insects arranged according to classification.
Foreign insects in all orders.
Microscopic slides of minute insects and insect anatomy.
c. *Curiosities (arranged for public exhibition).*
Gaudy or striking forms of insects, native and foreign.
Curious specimens of insect architecture and injury.
d. *Plates.*
250 colored plate-engravings of insects in all orders, together with their larvæ, pupæ, and cocoons where known.

Section D.—Botanical Series.

SUBSECTION I.—FOREST WOODS.

a. *Sections of forest woods of the United States.*
b. *Sections of forest woods, foreign.*

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*The cabinet of entomology is exhibited in Room 20, adjoining the museum, and the collections are arranged in three large cases built on the same pattern as the museum lower-cases.

SUBSECTION II.—VEGETABLE PRODUCTS OF BOTANICAL INTEREST.

a. Roots.
b. Barks.
c. Fibers.
d. Miscellaneons specimens.

SUBSECTION III.—CARPOLOGICAL COLLECTIONS.

a. Cones.
b. Acorns and nuts.
c. Leguminous fruits.
d. Soft fruits.
e. Capsules, and miscellaneous fruits and seeds.

Section E.—Miscellaneous Collections.

SUBSECTION I.—VEGETABLE SUBSTANCES USED IN MEDICINE.

a. Roots, barks, and woods.
b. Leaves, flowers, and fruit.
c. Preparations.
Extracts and tinctures, as laudanum, &c.
Approximate principles, morphine, quinine, &c.

SUBSECTION II.—SOILS.

(The present collection, principally American soils, has not been classified or arranged.)

SUBSECTION III.—FERTILIZERS.

a. Vegetable origin.
Sea-weeds, peat, or muck, &c.
b. Animal origin.
Fish and other guanos, animal refuse, &c.
c. Mineral origin.
Phosphates, marl, greensand, lime, gypsum, &c.

SUBSECTION IV.—FARM IMPLEMENTS.

Models of farm machinery.
(The present collection is also quite small and incomplete.)

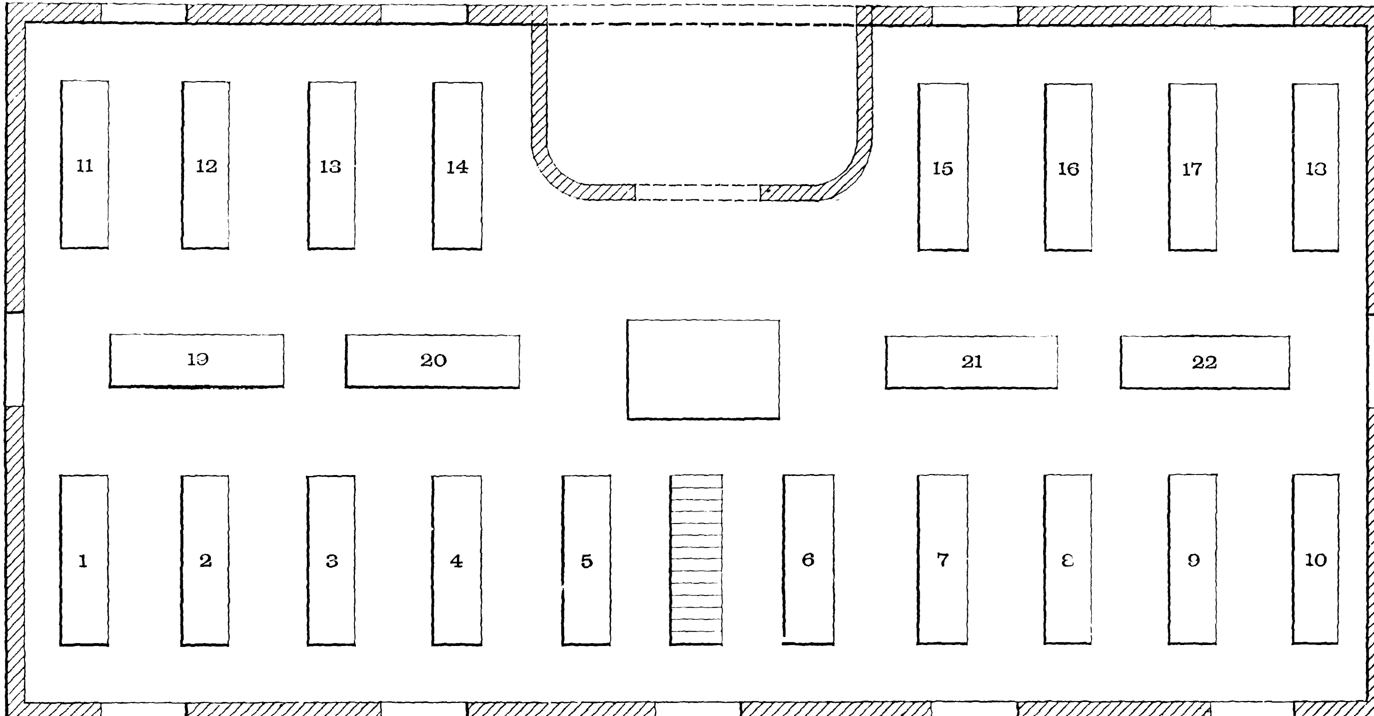
SUBSECTION V.—CASTS ILLUSTRATING DISEASES OF FARM ANIMALS.

Cattle.
Casts of stomach and other portions of the body as they appear in Rinderpest.

PLAN OF THE MUSEUM.

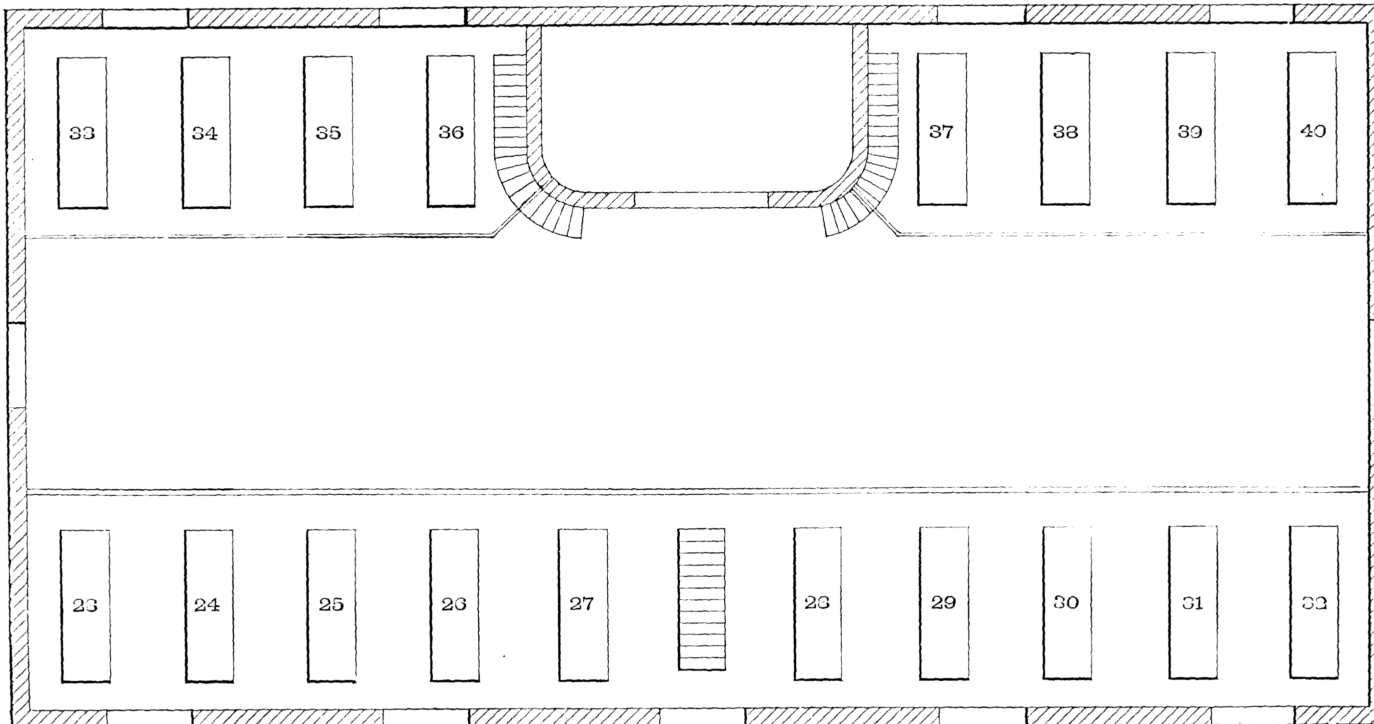
To give a better idea of the relative size of the museum and the number and position of the cases, the accompanying diagrams have been prepared, and the various collections, according to the above classification, are disposed in the following manner:

The cereal collections are arranged in the northeast portion of the



M. JOYCE, WASHINGTON

Plan of Museum. Main Floor.



Gallery in Museum.

museum, occupying eight cases—three upon the main floor and five above. In Case 1 are arranged the specimens of grain collected at the Paris Exhibition of 1867, with a few specimens of English and French grain upon the upper shelf. Case 2 is occupied by a large collection of maize. The specimens on the first and second shelves are exhibited on black wooden tablets, while the shelled corn, placed in glass jars, occupies the shelf above. Wheat, rye, barley, oats, and buckwheat occupy Case 3, and Cases 23 to 27 in the gallery above are filled with foreign cereals, secured at the Centennial, but not yet classified. The farinaceous products are placed in Case 4, a few specimens of grass-seeds, rice, and legumes occupying the lower shelf.

Case 5 is devoted to American and foreign tobacco, the foreign samples placed below, the American leaf-tobacco, in uniform boxes, occupying the middle shelf, while the top of the case is devoted to the manufactures exhibited in glass jars. In Cases 11 and 19 to 22 are arranged the large series of fruits and vegetables modeled in plaster, the last four being low cases with glass tops. Cases 12 and 13 are occupied by fruits in alcohol, sugars and sirups, beverages, liquors, &c., spices, condiments, &c., and aboriginal foods. The paper collection has been arranged in Case 14, the American samples occupying the middle shelf, the Japanese samples the third shelf, while the remaining foreign samples are placed below. Textile fibers occupy the entire southwest portion of the museum, and are arranged in the following order: Silk, Case 15; wool, Case 16; ramie and flax, Case 17; cotton, Case 18; Case 37 (gallery), jute, malvaceous, and lace-bark fibers; 38, 39, and 40 miscellaneous, vegetable fibers.

The natural-history collections, excepting the insects, are placed on the main floor in the northwest portion of the hall. Case 6 is devoted to animals (farm pests or small animals found upon the farm), and 7, 8, and 9 are occupied by domestic poultry, game birds, &c. Case 10 is occupied by the collection of small birds beneficial or injurious to agriculture, and to the larger birds of prey, as hawks, owls, &c. The remaining cases in the northwest gallery (Nos. 28 to 32) are devoted to gums and resins, oils, fats, wax, &c., dyeing and tanning material, specimens of materia medica, and the miscellaneous collections enumerated in Section E. This portion of the museum, however, has not at present been systematically arranged, although a majority of specimens have been placed on exhibition. The gallery cases in the southeast portion are devoted to the collection of forest woods and botanical objects; they are numbered 33, 34, 35, and 36. The center of the hall is occupied by the large redwood table, from one California plank, and supports an ornamental vase hewn from coquina or shell-rock of Florida, and filled with native ornamental grasses. The entomological room is just west of the museum hall, and is provided with three walnut show-cases similar to the fruit-cases in the museum. Upon the walls are displayed a portion of the economic collection of insects prepared for the Centennial, together with the elaborate collection of copper-plate engravings, numbering some 260 plates.

FOOD-SUBSTANCES.

Cereals and legumes.—During the last two years the additions to the collections of grains and cereals have been very large. From our own country a collection of over eight hundred specimens of maize, wheat, rye, barley, oats, buckwheat, beans, pease, &c., gotten together as the grain exhibit of the department at the Centennial, has been given place in the museum. The specimens were carefully selected from particular

localities in the different States by correspondents of the department, who were desired to send only the principal varieties best suited to their respective localities. The collection is thus a fair exhibit of the cereals of the United States grown in 1875. In glancing over the collection of wheat, a few prominent varieties, as the Tappahannock, Mediterranean, Fultz, Lancaster, &c., are observed to be of general culture, while others seem to be grown exclusively in a certain State or section. In some instances it is probable that old varieties have been given new names as there are many names with but a single specimen occurring in the whole collection.

In the New England States we find the Lost Nation, Tappahannock, and Lancaster Red Chaff the most commonly cultivated; while samples of Arnautka, Canada, Hybrid, White Laisette, and White Italian occur. New York adds Diehl, Treadwell, China Tea, and other varieties. In the remaining Middle States and Maryland, Virginia, and North Carolina we find Fultz and Mediterranean grown; Tappahannock, White Canada, and Golden Chaff are also represented. Ohio has sent nearly the same wheats as are grown in Pennsylvania, only one name not previously occurring, that of "Todd" wheat, being observed. Indiana and Illinois grow Lancaster, Michigan, Amber, Tappahannock, Odessa Red, Fultz, China, Missouri, Velvet, Early, Oran, Scotts, Egyptian, and two or three other varieties. In the Missouri collection we still find Fultz and Odessa, together with New York Flint, Independent Spring, &c. Iowa contributes Rio Grande, Canada, Fife, and White Chili. Among the varieties grown in Minnesota are Scotch Fife, Rio Grande, and China Tea, before mentioned, with the addition of Eureka, Early Sherman, and White Hamburg. Michigan sends Diehl, Gold Medal, and White Mountain.

The wheats of Kansas and Colorado, approaching in appearance those of California, are White Colorado, White California, Turkey, and Colorado Red Chaff, while Nebraska gives the names of Priest Spring, Otoe, and Russian Club. Among the wheats of the Pacific coast, principally white wheats, the White Australian appears to be the general favorite. The White Chili is also grown, and such varieties as Canada Club, Jones, Propo, Bride of Butte, and Nonpareil are represented in the collection. From Texas and New Mexico we have Sonora and Zaragoza. From the remaining Southern States the collection of wheats is very meager.

In this series there are but 35 samples of rye from various localities throughout the United States. The most interesting specimen is the Montana rye, which, in color and size, resembles a wheat, but has the form and characteristics of rye. It was first sent to the department from Montana, under the name of Goose wheat. The berry is quite large and very hard, and is said to make a superior flour.

Among the oats, the Norway, White Shonen, Surprise, and Probstier seem to be the favorites, the three last named having been introduced by the department. There is also a specimen of the so-called hull-less oats; barley and buckwheat are tolerably well represented, and there are a few specimens of sorghums and grass-seeds. The collection of pease and beans is quite small, but represents the leading varieties in cultivation.

The foreign collections of grain are quite large, and embrace a score of countries, scattered over the globe. As has been previously stated, many of these specimens have not yet been placed in the museum, and none of them have been examined. From a casual observation it is to be inferred that the finest foreign specimens, especially of wheat, are to be found in the Australian group. Specimens were secured from Vic-

toria, weighing from 61 to 68 pounds per bushel. New Zealand has also some remarkably fine white wheats.

A very large miscellaneous collection of agricultural products from the Netherlands contains a number of fine samples of oats and barley; there are a few good wheat samples, but a large part of the collection is made up of beans, pease, millets, &c., in variety. In the Peruvian collection there are several varieties of very large maize, similar to the Caragua corn sent out by the department a few years ago; some of the grains are nearly an inch long; it is exceedingly light in weight, consisting almost wholly of starch, and is very inferior in quality. From the Chilian department a very fine grain collection is secured. The wheats and barley are especially fine; the collection includes, in addition to the principal cereals, vegetable and other seeds, a great variety of edible nuts and other vegetable products.

From Peru, Argentine Republic, and Brazil, there are limited grain collections, pease and beans being more fully represented. Interesting collections have been added from Turkey, Spain, Portugal, Norway, and Sweden, which fully illustrate the agriculture of those countries, the cereals forming the principal parts of the collections. A small series of Russian cereal productions have been secured, but together with the collections from Spain, Portugal, South Australia, Victoria, Queensland, Tasmania, Egypt, Brazil, and Mexico, have not been unpacked further than to examine the contents of the bags to learn their condition. More than half of the countries presented their collections as exhibited in the original jars, and such collections were placed without further preparation upon the museum shelves.

A series of 1,400 specimens secured at the Paris Exhibition of 1867, and representing 22 countries of Europe, Asia, and Africa, is worthy of passing mention. The collection occupies two-thirds of Case No. 1, on the floor of the museum. The upper portion of this case is filled principally with French and English cereals secured from various sources, many of them being samples of grain either sent out by the department or offered to the department as varieties worthy of dissemination in this country. The fine collection of 200 specimens of wheat, rye, barley, oats, sent by Vilmorin Andrieux & Co., Paris, seedmen, is still in good state of preservation. They are put up in glass tubes, and exhibited with a head of the grain, the whole mounted in walnut cases 2 by 3 feet, and covered with plate-glass. One of the ten cases has been somewhat injured by insects, though the remainder have been thoroughly cleaned and are in perfect order.

Fruits and vegetables.—This class of agricultural products is chiefly represented in the museum by models made of plaster soaked in boiled linseed oil and painted in oil colors. Wax has been tried, but not found permanent; the volatile part evaporating, and the model shrinking, is destroyed.

A collection of tropical fruits made of *papier-maché* was purchased in 1871, and others have been made of various compositions to test their value for modeling purposes, but nothing has been found superior to plaster for the class of work required.

For models of large size, compositions of which paper-pulp is the basis may be employed with advantage.

The original specimens are obtained by donation or purchase, and are selected to illustrate the horticultural products of the country in all their marvelous variety, not only by single specimens, but by a sufficient number of each kind to show the modification caused by soil and climate, which have in the United States a wider range than in any other nation

in the world, except perhaps Russia. A collection which should give a full representation of all the fruits and vegetables that may be produced in this country and used as food for man, would exhibit a variety and richness as yet undreamed of.

The specimens in such a collection are imperishable, except by the destruction of the building containing them, and will offer to the future cultivator the means of solving many problems that are now only matters of conjecture. It is a favorite theory of some horticulturists that the life of a variety, propagated by buds or grafts, is dependent on and limited by that of the original tree, or at least that the period during which it will thrive and may be profitably cultivated has some natural limitation. A collection of models, allowing comparisons to be made in future of actual specimens with *fac-similes* of those grown many years previously, will, we think, demonstrate the utter fallacy of this theory, by showing that deterioration in the quality of a particular kind is usually local and often temporary, and that conditions of growth similar to those surrounding the parent stock will produce results of equal excellence; hence, that the life of a variety may be indefinitely prolonged.

The cultivated fruits now in use have unquestionably been derived from certain wild species, and it is very probable most of the modification has taken place since the historic period, if not since the Christian era. It may sound like a frivolous chimera to suggest the possibility of a collection of fruit-models enduring for centuries, and yet articles of a more perishable nature are now among our most certain historical records, and if we could find a few models of the fruits known to the Greeks and Romans they would aid us much in the solution of some of the most interesting and important questions of fruit-culture. The models now in the museum represent more than 400 varieties of the apple, 300 of the pear, 150 of the plum, about 100 of the principal tropical fruits, and nearly 200 melons, potatoes, &c. Of the standard kinds of apples and pears there are numerous duplicates, swelling the number of models to nearly 2,000, making a perpetual fruit-show that may be studied at any season. The largest apples grown are Gloria Mundi, which appear to thrive in all parts of the Union, though nowhere considered a profitable market fruit.

The heaviest apple whose model we now have in the collection weighed 29 ounces, and grew in Nevada; but a little heavier one from Oregon has since been received.

A comparison of specimens from all parts of the country shows that apples originating in the Eastern States usually gain in size when grown in warmer parts of the West, but lose something of intensity of color, and perhaps of flavor. Varieties differ greatly in amount of variation, the Baldwin changing most of all.

The hilly portions of the Southern States have repeatedly sent us as fine specimens of apples as can be produced anywhere else, and even in the extreme South, along the Gulf, there are certain varieties, like the Green Cheese, that thrive, and keep "till apples come again." The keeping quality, however, in apples grown on the Southern lowlands is the exception, not the rule.

We frequently receive certain interesting monstrosities that seem not uncommon in the apple. Among them are twin or triplet apples, two or three grown in one; the Surprise apple, with red flesh, occurring in Wisconsin; apples having one side russet and the other smooth, the line of division being very straight and distinct, usually from stem to eye, but sometimes transverse. These are the apples sometimes reported to result from uniting the halves of buds from two different

varieties in inoculation, but there is nothing whatever in the history of the trees producing these specimens to confirm this theory. Apples are sent to us from Plainfield, Mass., that are strongly pear-shaped, growing on the same branch with round ones; but perhaps the most interesting curiosity of all is a coreless apple, in which the fruit is turned inside out, leaving a small cavity open to the air where the core should be, while rudimentary seeds are produced on the outside of the apple.

The collection of models of pears contains nearly every variety of standard excellence. Compared with the apple, new kinds are seldom brought to public notice, notwithstanding the high price paid for first-class fruit. There are, no doubt, many varieties which, when grown as standards, are more regular in bearing than the apple, but the additional care required in ripening and keeping them in winter seems likely to prevent cultivators in general from giving this fruit the attention it justly deserves. Many visitors to the museum are surprised by the exhibit of three pears from Clackamas County, Oregon, the originals of which weighed four pounds each, and measured in circumference, respectively, 18 and 20 inches.

We have several times received specimens of a quince weighing from two to three pounds, said to come from Japan, but which is entirely different from the fruit of the flowering Japan quince (*Pyrus Japonica*) It is probably the Portugal quince, which is of excellent quality, but whose shy habit of bearing has hitherto prevented it from finding favor with cultivators.

Our plums are chiefly from the Hudson River region, where, with a part of Western New York and New England, this fruit is more in cultivation than anywhere else in the United States. A small fruit from Japan, called the Japanese plum, is much grown near New Orleans, where it ripens early in winter and is a great favorite. Its Asiatic name is Li-tchi or Longan, and it is not a plum at all, botanically speaking, but belongs to the sapindaceæ or horse-chestnut family. There are many varieties of this fruit cultivated in China, some of which are described as much larger than any we have received, and it is doubtful if the best kinds are yet in cultivation here.

The models of cucurbitaceous fruit include the melons, squashes, &c., usually grown, with some comparatively rare. The number of varieties in this family is immense, and a caprice akin to fashion often seems to influence the amount of popular favor granted to certain kinds. Queen Anne's pocket-melon, a small musk-melon once in high repute, was so nearly extinct that a few seeds only were preserved by accident. Not long ago the Japan apple-pie melon was extensively grown, but is now almost unnoticed. Among the rarer specimens in our collections is the Soolyu, a Chinese cucumber as large as a water-melon, introduced into Europe some time ago, the cultivation of which does not, however, appear to extend. From New Orleans we have the banana-squash, the flavor of which is said to resemble a banana. It is from four to six pounds in weight, shaped like a cucumber, and of an orange color. The snake-squash, usually grown as a mere curiosity, has been brought to us as a candied preserve of such superior excellence as to deserve particular notice.

Among the models of eighty varieties of the potato are some of the tubers of *Solanum Fendleri* of New Mexico. These tubers were quite small when first received, but increased very much in size during three years of cultivation. There are nearly one thousand species of the genus *Solanum*, many of which have edible tubers, besides *S. tuberosum* (the com-

mon potato), and it is not at all impossible that species not now in cultivation possess qualities worthy of attention.

Although the Indians use considerable quantities of the cactus fruits of our Western plains, it is hardly probable they will ever be considered worth cultivation by us. The fruit of the European prickly pear (*Opuntia ficus Indica*) is frequently eaten in Spain and Italy, and the specimens we have received from the Mediterranean are much larger and more attractive than any of our native fruits of that family.

Most of the principal tropical fruits are represented in the collection, many of which are already grown in the extreme southern portions of the Union. Pre-eminent among these are oranges and lemons, of which California sends the finest specimens yet received; the banana, mango, South American pawpaw, &c.

It is certain we are very far from employing the full capacity of our soil and climate in the production of fruits of the warm temperate zone, for we have as yet no adequate representation of the orange family alone. The quality of our production is established by the high price Florida oranges command in our markets compared with those brought from Europe, to which they are much superior in size and flavor.

Numerous inquiries, both official and private, have been received from time to time as to the method of making plaster models of fruit. The process is essentially simple, depending more on the mechanical tact and artistic skill of the operator than any intrinsic difficulty. The tools and materials necessary are some common bowls, spatulas, fine sand, calcined plaster of Paris of the best quality, boiled linseed-oil, artist paint-brushes, and tube-colors, such as are used for painting on canvas. The apple or pear of which a model is required is buried in a bowl of sand so as to expose precisely one-half the fruit, the surface of the sand touching its largest diameter. The bowl or other vessel should be three-fourths of an inch larger all round than the specimen, which is now covered to the depth of half an inch or more with plaster mixed to the consistence of thick cream. In about fifteen minutes this coat will set, when the half mold and specimen may be lifted out of the sand, some of which will probably adhere to the moist surface, and should be brushed off. In order to secure that the second half of the mold shall accurately fit the first, a notch is cut in the upper edge of the latter and three small nails driven in at equal distances. The edge of the mold is oiled, and sufficient plaster poured on to make the second half. In an hour or two it will be hard enough to permit the separation of the two parts by tapping a cold-chisel inserted in the joint, when the fruit is removed, leaving a perfect fac-simile mold of the original. The inside of this mold must be thoroughly oiled, then filled with plaster, each half separately, a little more than full, and when the two parts are pressed together the surplus material will be forced out between the halves of the mold. Whenever the models are large enough to admit of it the soft plaster is spread up the sides of the mold with a spatula, so as to leave the central portion hollow, $\frac{3}{4}$ to 1 inch being a sufficient thickness for the model, which, when very long and slender, or very large, is strengthened by inserting stout wires in its substance. In a few hours the cold-chisel may be again used to separate the mold, when a perfect model should be obtained, only marred by a thin band at the parting of the mold, which must be pared off with a knife. Various kinds of oil or compositions are used as parting fluids. We prefer a mixture of paraffine and lard-oil. Warm a pint of oil and dissolve in it half an ounce of paraffine, stirring it occasionally till perfectly mixed, when it will remain ready for use. The proportion of paraffine may be varied without detri-

ment according to the season. The oil will soak into the plaster and leave a smooth, delicate coat of paraffine on the surface.

The most usual imperfections are air-bubbles. These can only be avoided by skill in manipulation. In mixing the plaster it may be sifted through the fingers into the water, stirring as it thickens, or the water may be poured in a given quantity of plaster. The first methods permits the escape of air more readily than the second. Beginners usually mix the plaster too thick; it should flow readily, but should contain no free water to run over the top. By shaking some thin plaster over the surface of the mold, and then filling just before it is ready to solidify, a smooth and perfect model may be obtained.

When the molds have been made some time before using they become so dry as to abstract water too rapidly from the fresh plaster used to fill them, and they should then have a coat of shellac dissolved in alcohol before oiling. A fresh coat of oil is necessary each time the mold is filled. When objects are too large to set in a bowl or other similar vessel a lead ribbon is a convenient substitute. A strip of thick sheet-lead, about six feet long and four inches wide, may be set edgewise on a sheet of paper, and bent around the fruit, and sand poured in as in any other vessel. Still larger specimens, like melons or pumpkins, require a sort of scaffolding of pieces of cardboard, thin wood, &c., built to support the edges of the mold, which must be constructed in many pieces, so arranged as to readily draw off from the model according to the shape of the specimens. After the model is made it must be thoroughly dried, which requires from three days to a week, according to size and temperature. It must then be soaked, or, if large, brushed over with boiled oil till saturated one-quarter to a half inch deep, and after the superfluous oil is wiped off allowed to dry a second time, when it is ready for painting.

The ordinary artists' brushes, colors, &c., are used for this work, the success of which depends entirely upon the skill of the artist and his ability to produce the desired effects. A convenient support to the fruit while painting is made by inserting a brad-awl where the stem should be—the brad-awl may be set in a wooden foot—and the model is finally completed by fixing in the hole left by it a stem made of a piece of copper wire, on which is molded gutta-percha to the proper size and shape.

Besides the fruit, the museum contains about 200 models and preparations of the more important edible and poisonous fungi. A much larger proportion of the various kinds of mushrooms, &c., are eatable than is generally supposed, but a prejudice has grown up from the want of knowledge concerning them that will take a long time to eradicate. Nevertheless, they contribute no mean portion of the food-product of the world. The Patagonians use large quantities of the *Cyttaria*, a fungus they collect and preserve by drying. In Germany and Italy mushrooms are in common use, and are of many varieties. In England and France the truffle and cultivated mushroom are among the delicacies of the wealthy. Although but one Agaric is cultivated among us, the Japanese grow several species on logs of decaying wood prepared in a peculiar manner, and, besides the home consumption, exported to China in 1874 to the value of $61,000.

We have received from the northwest coast immense specimens of *Polypori* and *Clavaria*, and from Sitka a bright red fungus, used by the Indians as paint, as yet undescribed. The curious subterranean production called tuckahoe, or Indian bread, common in the Southern States, is represented by specimens weighing more than four pounds. According to the analysis made by the department (see annual report, 1871), it is

chiefly composed of cellulose and pectine. Its fruiting condition is as yet unknown, and its real affinities cannot, therefore, be described.

A few jars of fruit preserved as specimens in alcohol have long formed a part of the museum, and to these have been added a large number from the Centennial Exhibition. Some of these were filled with brine on which mold collects rapidly, and the fruit soon spoils. Numerous experiments on the preservation of fruit specimens made in the museum, prove that a saturated aqueous solution of borax with a few drops of corrosive sublimate is preferable to alcohol, causing less shrinkage and less discoloration, though no means of preventing the latter has been discovered. Such a solution will sometimes require filtering, but it is cheap and evaporates very slowly.

The specimens of fruit received from the Centennial Exhibition are from Australia, South America, and Japan. In the former country oranges and lemons are very successfully cultivated, seventeen varieties being exhibited at Philadelphia, of which, however, we have received but ten, as follows:

Oranges.—Common, Navel, Siletta, Seville, Mandarin, Poor Man's, Maltese Blood. *Lemons.*—Lisbon, Bergamot, Citron-fruit.

The Lisbon lemon is similar in form but of larger size than those usually found in our markets. The Bergamot is of the size and shape of a large smooth orange, and is evidently one of the varieties of Citrus limetta, some of which have sweet fruit. The citron or citrus medica is the fruit commonly sold in our markets in a candied state. Of the oranges the Seville is very large with rough surface, and a cavity in which the stem is inserted.

The Navel takes its name from a small protuberance on the blossom end, and is one of the kinds most highly esteemed in Brazil, where it probably originated. The Mandarin or Canton Mandarin is from China, has an exquisite flavor and a sweet eatable rind, but is of small size, from $\frac{3}{4}$ to $1\frac{1}{2}$ inches in diameter. The ease with which new kinds are produced from seed in the orange family renders it probable that as many varieties will shortly be cultivated as are now grown of the apple. Very few, however, have yet been described in books which are generally accessible.

In the Venezuelan collection are specimens of the chayote (Sechium edule), a cucurbitaceous fruit, cultivated in South America, which would no doubt grow during our hot summers. It is about six inches in diameter, with a rough rind, and is used like a squash. The collection from Venezuela also contains specimens of the various custard-apples and other tropical fruits of very large size.

The similarity of the climate of Japan to that of our own country lends to its productions a particular interest. From her exhibit at the Centennial we received twenty varieties of oranges, peaches, plums, figs, and persimmons, all of which are sorts peculiar to that country. Of the persimmons there are five kinds, from two to three inches in diameter, and their appearance fully confirms the descriptions given of what is undoubtedly the most valuable contribution made by Japan to our list of fruits.

FARINACEOUS SUBSTANCES.

Among the manufactured substances from the cereals or from fruits are many of the coarser food preparations that have become so popular of late. Wheat is shown in the natural berry with no other preparation than simply removing the hull, called "breakfast wheat." Then follow samples of steam-cooked and crushed wheat, and coarse and fine cracked wheat, one of the finer specimens bearing the trade-name "Nutrina."

"Hecker's farina" is a food preparation from wheat resembling finely granulated pearl barley, and pearl barley is represented by a full series of specimens, from finest to coarsest, the large sample simply with the husk removed, and preserving nearly the form of the grain. Avena is the coarsest of our food preparations from oats; the berry or grain is preserved in nearly its original shape, first having been hulled and then coarsely broken. There are numbers of grades of hominy, and all manufactured from white corn, from specimens with simply the hull and eye removed and in nearly its normal shape, to a very finely granulated product called "breakfast hominy." The coarser wheat-foods for animals are also included in the collection of "grits," as bran, shorts, shipstuff, middlings, &c., and the whole group numbers some fifteen specimens. In the collection of meals and unbolted flour there are sixty specimens, largely from corn, wheat, and rye. The corn-meals include coarse and bolted meal from yellow and white corn, with intermediate grades suited for the various purposes of culinary art. Samples are also shown from Turkey, Sweden, Argentine Republic, Chili, and Mexico. From British Guiana there is a series of meals from the sweet and bitter cassava, accompanied by the dried root from which they are prepared.

The collection of flour is quite large, and comprises not only the best grades of American flour, but many foreign specimens. Among the American specimens an interesting series of thirteen samples illustrates the manufacture of the "patent-process" flour from the uncleaned grain as received at the mill to the first grade flour, with all the intervening products, and the refuse and dirt (chaff, rubber dust, &c.) which is separated by the process of manufacture. Samples of self-raising flour and flour from desiccated sweet-potato and from rice (the last-named forming a very delicate food) are shown. In this group there are at present in the museum 64 samples.

The starch collection is quite large, and includes specimens from various countries and derived from different sources. In addition to the various preparations of food-starches by American manufactures from corn or other cereals, including maizena and the fancy preparations, similar series have been secured from other countries, even as remote as Australia and Japan. From South America interesting specimens have been received peculiar to that country, principally Brazilian and Venezuelan. The collection includes starch from the sweet and bitter cassava (*Jatropha manihot* and *janopha*), from the banana or plantain (*Musa paradisica*), from the sweet-potato (*Batatus edulis*) and yam (*Dioscorea bifidia*), ocumo starch (*Colocasia esculenta*), and arrowroot (*Mavanta arundinacea*).

Several specimens of starch were presented with the Mexican collection, among them starch from *Cicer vulgaris*, *Vicia fabæ*, *Phasseolus vulgaris*, *Pisum satioum*, and *Sechium edule*. This last named is an indigenous plant called "chayote," which is said to give a starch as pure as arrowroot, which is contained in the heavy "tubercular" roots. The plant also yields a fruit, which is of excellent quality. Its roots cannot be utilized until the second year. They can be removed without killing the plant, and the operation may be repeated for six or eight years.

With the Japanese collection a number of very interesting starches were secured which are peculiar to Japan. "Kudzu" is manufactured from the root of *Pueraria thunbergiana*. It is very abundant in certain localities, and yields the finest quality of starch. The root is frequently over five feet in length and as thick as a man's arm. For the manufacture of starch by the ordinary process of crushing the root and washing the starch and decanting it, however, the smaller roots, an inch in thickness and not more than a foot in length, are generally used. This starch is of a fine

color, and its flavor is most agreeable. It is used as a mucilage by mixing with warm water, forming a firm, transparent paste. The "Kata-kuri" is another starch, made from the root of a species of dog's-tooth violet. A third kind of starch is prepared from the root of the fern (*Pteris aquilina*). Both of these starches are used as food, but the fern-root kind is also used in the arts, as it is capable of manufacture into a strong gum, or paste, called "shibu," by carefully mixing it with the sap of unripe persimmons (this fruit is described under the head of FRUITS AND VEGETABLES.)

After the starch has been extracted from the fine roots the fiber that remains is made into ropes, which are used to strengthen the mud-walls of buildings. There is nothing peculiar in the method of preparing the two last-named kinds of starch. All three species of plants grow wild, and are comparatively abundant. Starch-sugar is another product of Japan, millet and rice being used for its manufacture. The grain is first steamed, then mixed with a certain quantity of malt or ferment, and kept at a certain temperature for a number of hours in close vessels; the liquid portion is strained and concentrated by evaporation to a strong sirup. This is formed into bars when quite hot, forming a solid mass. Quite a collection of other allied starch products, as sago, tapioca, mandioca, &c., have been added to the museum. The two last named are of South American origin, and are the product of the cassava previously mentioned. The "farinha" of the Brazilian is manufactured from this root. To prepare it, the root is ground up, the juice expressed, and the remaining mass heated and dried in large iron pans over a slow fire. The juice of the bitter variety is extremely poisonous, but this quality is overcome and rendered harmless by heat. Farina from bread-fruit (*Artocarpus incisa*) is also shown, together with specimens of the above. For convenience in classification, the laundry and sizing starches, with similar products belonging properly to the section devoted to the arts and manufactures, have been placed provisionally with the "food products," as they form but a very small percentage of the collection of farinaceous substances.

Among the miscellaneous exhibits in this subsection there are several samples of a bread from Sweden which is particularly interesting. This bread is made of rye and wheat, prepared in large cakes the size of a dinner-plate; they are about an eighth to a quarter of an inch in thickness, are pricked with little holes forming indentations in the surface, and resemble huge crackers. The color is a dark brown, like well-baked bread-crust. It is made but once a year, and the batch is hung up in the loft of the peasant's home, strung in rows by means of holes left for the purpose. It is quite palatable, one variety being flavored with aromatic seeds.

A singular bread made by the natives of Santo Domingo, baked in rude cakes six or eight inches in diameter, is on exhibition here. It is manufactured from grated cassava, and has the appearance of fine sawdust slightly browned in spots.

SUGARS AND SIRUPS.

The native collection in this subsection is confined to specimens of Louisiana and Cuba cane-sugar refined within our own borders. Samples of a rude sugar manufactured by the Mexican Indians from the Labba cane, called Panocha, is worthy of mention as a novelty. It is formed in small cakes, not weighing over a pound, in little holes scooped in the ground. There is a large series of sorghum samples (raw and refined sugars and

grades of sirups), illustrating the sorghum-sugar industry that sprang into existence during the war, and was a considerable source of revenue to the Northwestern States for a number of years. Within the last five years, however, no samples of the sugar have been added to the collection.

Beet-sugar is shown as the result of experiments conducted in this country, at Fond du Lac, Wis., at Chatsworth, Ill., and by the Sacramento Valley Beet-Sugar Company, in California. Specimens of the dried beet-root is also shown, with crystals of sugar, sugar-loaf, &c. In the maple-sugar series are exhibited sugar in cakes, granulated sugar, and sirups. One sample is shown from Vermont as white as "A" coffee sugar, and resembling it. The majority of samples are from the New England States or New York. The series of foreign sugars added to the museum have been quite large. The Australian collection embraces thirteen samples of cane-sugar from various Queensland manufacturers, and twenty samples of all grades of cane-sugar from New South Wales, furnished by the Colonial Sugar-Manufacturing Company. There are other samples also from Victoria, Tasmania, and South Australia. Cane-sugar has also been received from various localities in South America, the finest specimens coming from Brazil. Russia presented a collection of beet-root sugars numbering about twelve specimens, and smaller collections were received from various other localities. These, however, have not yet been placed in the museum. In the Japanese exhibit there are several jars of sugar, but it is not at present known from what source they were derived. A novelty in the sugar series is a sample made from corn.

BEVERAGES, LIQUORS, AND NARCOTICS.

The principal tea collection is a series of 150 samples in the original bottles, and under Japanese labels, secured from the exhibit of Japan at the Centennial Exhibition. Here are shown all grades of tea, marked with the price in Japan, in English characters, together with other substances used by the poorer classes as substitutes for tea, or it may be for adulteration. The collection is quite a valuable one to the museum, affording means of comparison and reference. Among other stimulants coming under this category may be mentioned maté, or Paraguay tea, (*Ilex paraguayensis*) and *Ilex cassina*, formerly used as a substitute for tea by the North Carolina Indians to make the celebrated "black drink." Coco (*Erythoxylon coco*) is worthy of mention in this connection. The leaf is used as a gentle stimulant by holding in the mouth or slightly chewing. In some portions of South America it is used with great advantage for sustaining strength in fatiguing journeys on foot.

Cocoa (*Theobroma cocoa*) and its many preparations are represented from various countries, one of the largest collections having been secured from the Venezuelan exhibit. There are twenty samples in this collection, and one specimen of the fruit in alcohol. The cocoa of Chuar, of which there is one sample, has the reputation of being the best in Venezuela, and has no equal in the world. Three specimens of chocolate are also shown with this series. Brazil also contributes a collection of cocoa, though somewhat smaller than the above, and there are a few other specimens from other localities.

Coffee (*Cafea arabica*) is shown in all its varieties, Brazil and Venezuela both contributing very large and complete collections. From the former a collection of over twenty specimens has been received, while the latter donated their entire collection, some twenty-five different kinds. It is principally shown in the berry, though two or three samples exhibit it in the husk or outer covering. From the Argentine Republic a small series

was also received. In Venezuela 1,000 to 1,500 coffee-trees are planted on about one and three-quarters acres of ground, and a well-developed tree yields about half a pound of marketable coffee. Dwarf coffee (specimens shown) is the result of checked development in trees growing in poor soil, or it may result from dry weather. Laguayra, Maracaibo, and Puerto Cabello coffees are the best known of the specimens exhibited in this series.

Wines and liquors, though admitted in the classification, are not represented as a class in the collection. A few specimens from Russia and from Peru were presented. There are also samples of pulque from Mexico, manufactured from the liquor of agave. Tobacco, as a narcotic stimulant, is included in this subsection.

The American series comprises ninety specimens of pressed leaf-tobacco, representing twenty-one States, in various portions of the Union. The best sample is a Virginia tobacco that is said to have brought $4 per pound. With this series is another series of manufactured tobaccos (smoking, chewing, and snuff), showing the many forms of manufacture, and the kind of leaf used for the purpose. A specimen of wild Indian tobacco from Arizona is also shown. The foreign additions to the museum have been quite large, nearly every country represented at the Centennial presenting specimens of tobacco from their collections. The largest of these are from Brazil, Argentine Republic, and Japan. Cigars, cigarettes, and snuff were included among the donations. The foreign tobaccos, although on exhibition, have not yet been examined, though it is known the collection includes many interesting and valuable specimens. A few specimens of opium are shown in this group, as a narcotic stimulant. Its various other preparations as laudanum, &c., are shown in Section E.

SPICES, CONDIMENTS, ETC.

Here are grouped together collections of spices, showing in some cases how obtained. Nutmeg is shown from Java in its outer rind or covering, the same split open, showing the folds of mace, and lastly the nutmeg itself; the leaves of the tree are also shown. Ginger, cloves, cinnamon, and peppers in variety are shown from South America. Vanilla beans are exhibited from Mexico, and tonca beans from Guayama.

This series also includes the aromatic seeds, as anise, cardamom, cumin, &c., of which there are a number of specimens. The pot-herbs, or herbs of the kitchen-garden, are also included, together with the flavoring extracts. Among prepared sauces there are many samples of the celebrated "soy" (a Japanese condiment), and a few prepared American table-sauces. Olive-oil and its substitutes (pea-nut oil, &c.), are shown, together with "salad dressing," of which there are several preparations put up for market use. There are a great variety of preserved peppers from various parts of the world. Grated horse-radish, as prepared by a New York firm, is also exhibited.

ABORIGINAL FOODS.

As this series of specimens is more interesting taken collectively than when scattered through the different subsections of Section A, it has been given a subsection by itself. This collection is quite large, and illustrates to a certain extent the manner of livelihood of the North American tribes of Indians. Their cereal production is quite small, only a few specimens of wheat and similar grains having been added to the collection, and these principally from Indian Territory. Native varieties

of maize are exhibited from New Mexico and Arizona; the specimens are small and are unlike any other maize in the museum. From one variety (a blue-colored corn) a kind of wafer bread is made. It is as thin as card-board, and a greenish-blue in color. It is made by spreading the dough thinly over heated stones, cooking it immediately, and when a sufficient quantity is made it is hung up in their wigwams with other food supplies. There are coarse breads made from the "kouse" and "kamass" roots, the former a bulb abounding in starch. The roots themselves are shown in natural state, and sliced and dried. A series of grass-seeds, numbering about twenty specimens, is shown; these are carefully gathered and preserved as food supplies, and generally eaten mixed with other substances, a favorite food being pulverized crickets (*Anabrus simplex*), and grass seed worked into a kind of paste or dough and made into a rude bread. Crickets and grasshoppers are, however, eaten in other ways.

The larvæ of a small fly found about Lake Mono in California are collected in quantities and eaten by the tribes in the vicinity. The manner of using pumpkins and musk-melons is to cut in long strips and then dry them. This food is prepared in large quantities and stored for winter use. By the Indians of Arizona the fruits of a species of cactus (*Opuntia*) and of *Yucca bacata* are carefully collected and preserved. Smaller fruits, as the blackberry, soap-berry, &c., are dried and preserved, sometimes kneaded into balls.

The Indians of Mexico prepare the agave in various ways. The tender inside leaves are roasted and preserved in large masses, or the fiber is removed and the edible portion pressed into thin, flat, black-looking cakes. A liquor (resembling pulque) is also made by them from its juice and called "mescall." The screw bean and mesquite bean are gathered and pounded into a very coarse meal, often without removing the insects (*Curculios*) generally found infesting the beans, and a very coarse bread made from it, which serves for a part of their winter supplies. An interesting specimen in the collection is a quantity of blue clay, containing a large percentage of magnesia. This is eaten with the native potatoes, which are about the size of bullets, and as they eat enormous quantities, the magnesia is supposed to prevent any unfavorable results from such gourmandizing. Among the nuts gathered for food, acorns and the fruit of the piñon are the most prominent, forming, with some tribes, a large percentage of their food, so that in years of scarcity of these nuts there is much suffering. Among some of the tribes a more civilized diet prevails, and peaches and other fruits are dried and preserved in the same manner as with the whites.

A specimen of jerked beef shows the manner in which the buffalo is utilized to furnish a winter supply of animal food. Those tribes raising corn or grain also store it against a time of need, after the manner of the whites.

SUBSTANCES USED IN ARTS AND MANUFACTURES.

Textile fibers.—The collection of textile fibers is so large and extensive that only a passing mention can be given here, as a full report on the valuable additions to our already large collections received in the last two years will make a volume of itself. In the series of animal fibers, there are about five hundred specimens of American wools, and these were selected with great care by well-known breeders in different parts of the country, and include the principal breeds of sheep with their crosses known to American sheep-husbandry.

The various manufactures from wool are also shown with complete

series of samples, showing the different stages of manufacture. Thus are shown the kinds of wool entering into the manufacture of worsteds, flannels, clothing and piece-goods, carpets, &c. The foreign collections, especially from Australia, are equally fine, South Australia, Victoria, New South Wales, Queensland, Tasmania, and New Zealand, all being fully represented. Russian and other European wools were received, including fine collections from England. From the South American exhibits large collections were made, the most complete coming from the Argentine Republic. A majority of these wools are coarse and inferior, however, and used only in carpet manufacture.

The silk collection has been augmented by fine specimens of cocoons and raw reeled silk of *Bombyx mori* from many countries. The finest recent acquisition to this series is a large collection from Japan, and includes different varieties of Japanese cocoons and the silk reeled from them, many of the specimens being unique and interesting. The samples are not confined to *B. mori*, but include several varieties of silk from wild or oak-feeding varieties. One form of cocoon resembles delicate lace-work. Interesting collections were also received from South America.

The original or old collection of silk in the museum was quite complete, but the recent additions made it second to none in this country, and the equal of foreign museums.

Among the vegetable fibers the cotton collection includes specimens from nearly every cotton-growing region on the face of the earth, the largest series being four hundred samples from Egypt. About one hundred and fifty specimens of American cotton are shown as "lint," while another series illustrates the manufacture of cotton in this country, from the "homespun" of one hundred years ago to the finest products of the Manchester, N. H., mills, "peeler" cotton being shown step by step through the various stages of manufacture. Samples are also exhibited as manufactured by the government mills in Japan, and as rudely prepared by the natives of Chico, United States of Colombia. In flax a series of specimens from the flax-mills of Manchester have been added to the collection, showing the various manufactures. A series showing the result of experiments in cottonizing flax, as carried on during the late war, are still preserved among the flax collections. A few samples of flax were also secured from foreign countries. No new specimens of ramie have been recently added to the museum, though the old collection is quite full and entertaining, and gives the result of experiments in the South with this valuable fiber.

Jute is represented in a full series of specimens illustrating every stage of manufacture, and samples are shown, not only of the coarsest bagging, but of jute cloth and tapestry (the last of jute and cotton mixed), for upholstering purposes. *Apocynum cannabinum* is used as a textile by some Western tribes of Indians, and the museum specimens consist of stalks of the plant and raw and prepared fiber; there are also shown nets and fish-lines, sacks, baskets, belts, &c. The fiber is quite inferior, however, for most purposes.

A very complete collection of over one hundred specimens of New Zealand flax (*Phormium tenax*), illustrates the manufacture of that valuable product. The fibre is shown in all stages of preparation, and as rudely manipulated by the natives, who removed the woody matter by scraping with a shell. Among the manufactures are ropes, twine, fish-lines and fish-nets, halters, thread, coarse cloth, &c. Bagging is also made of it, and shown with mats and matting similar to that made from the Coir fiber. Some of the samples are very fine and in finish resemble linen.

Other foliaceous fibers are shown, as pine-apple, plantain, Manila hemp, Sisal hemp, &c., and a series of other agave fibers, showing the uses of this plant, such as coarse mats for saddle-cloths, brushes, &c. A beautiful collection of manufactures from *Agave sisalana* shows the delicate handiwork of the peasant women of Fayal, who use this fiber for the manufacture of their beautiful lace-work, which commands such prices in Paris. It was said by the donors that there were but twenty-five women on the island capable of producing this lace, as it requires practice from childhood.

There are about twenty specimens of malvaceous fibers, principally varieties of *Hibiscus*. *Abutilon avicennæ* is used to some extent by Indians, and is also used in the manufacture of brushes or dusters, a few feathers being inserted to hold the fiber in place. It dyes readily, but the colors are not fast. From the islands of the Pacific there is quite a series of Lace-barks and Tapa cloths (*Brousonetia papyrifera*), some of the last named already made into garments—if an article resembling a large paper bag, but open at both ends, can be called a garment. Some are stained with a dark coloring matter, and are checked off in squares or diamonds, like the figures of an old-fashioned quilt. Specimens of vegetable flannel are exhibited, said to be manufactured from the needles of *Pinus sylvestris*. Corn-husk is also shown made into a very good quality of toweling. It is also used as the fiber portion of oil-cloths. Asclepias fiber mixed with cotton is exhibited, with specimens of coarse cloth manufactured from it. The down from the seed vessels of this plant have been received as "vegetable silk." The substance is worthless, however, for purposes of manufacture.

A series of specimens of "silk-cotton" have been received from various localities in South America. Various species of bombax are represented, both free and in the seed-pod. It has no value as a textile, and probably could only be used for stuffing purposes. A few specimens of epilobum fiber are shown; its manufacture was only an experiment, however, no practical result having been obtained. It is therefore interesting only as a matter of reference.

From China there are a number of fibers which have been in the museum since its foundation, that were received without name and are therefore unknown, but by the aid of recent acquisitions from various other localities it is hoped they can be identified. They are manufactured into ropes, twine, and other articles of utility. The greater part of the Centennial collection of miscellaneous fibers have not yet been brought into the museum, so the specimens cannot even be mentioned by name. The collection is quite large, however, and contains much material that is new and interesting, and when eventually reported on in full, will be found to include many valuable specimens not met with hitherto in museums.

Paper materials.—The American series includes every known paper-making substance of any value, from the genuine *wood* paper, as manufactured for thousands of years by wasps, to the finest linen paper of the present day.

Among the less common substances may be mentioned paper from palmetto leaves, from leaves of *Yucca filamentosa*, from okra, from *Agave americana*, and from ramie. A very good brown or wrapping paper has been made from *Spartina cynosuroides*, a grass growing in marshes on the Mississippi, and samples from hay are exhibited from Colorado. The foreign collections represent most of our fiber-producing plants, showing the many sources from which this useful substance can be manufactured. Corn-husk paper from Austria and rice paper from

Japan are interesting novelties. The collection of Japanese and Chinese plain and fancy papers is quite a large one, and represents the entire paper industry of those countries, from the most delicate filmy paper used by jewelers for packing to the coarse heavy materials for screens or for wall decoration. The various writing and printing papers are exhibited, some of the former being very handsomely colored to represent birds, flowers, &c. Among other specimens are shown the papers used for handkerchiefs, &c., and as substitutes for window-glass; samples of imitation morocco are also exhibited. The Chinese papers in the museum are not so fine in quality as the above, though, it may be remarked, the series is quite small. The substances used are straw, mulberry, and bamboo; he straw and bamboo papers being quite coarse and inferior.

DYEING AND TANNING MATERIALS.

A series of interesting specimens in these two subsections were secured, and have been placed in the museum. Among the most noteworthy may be mentioned a number of specimens of madder from the Netherlands, comprising the root and different stages of its preparation. Samples of indigo are shown in the Japanese collections, and also from Venezuela, where it formerly was cultivated for export. Fustic-wood and dragons' blood are shown, with a great variety of unnamed woods, bark, and leaves used for coloring, principally from South America; the collections of Brazil and Argentine Republic being extremely rich in specimens of this group. Saffron and hollyhock flowers, annotto seeds and prepared annotto are also represented. Among mosses and lichens used for dyestuffs may be mentioned the different varieties of orchella weed (*Roccella*), from which the orchella paste is manufactured, samples of which are exhibited.

Canary rock moss, *Parmelia prelata*, and another form, *Umbilicaria pustrolata*, also belong to this series. Fungi used for dyeing is the old collection of the department received from Brazil.

The American dyes are represented by samples illustrating the manufacture of flavine from oak bark, indigo produced from native plants and by barberry root, orchella, cudbear, &c. Coloring matters of animal origin are represented by various specimens of chermes and cochineal, principally from South America. Dyes of mineral origin are represented by a large series of aniline dyes, both of American and Swiss manufacture, from coal-tar and petroleum.

An interesting series of tan-barks and other tanning materials of American origin were collected by the department for exhibition at the Centennial, and these have been added to the collection. Among the herbs and leaves lately discovered to be of value in this particular are *Ephedra antisyphillitica* and *Polygonum amphibium*. The tanning extracts from hemlock and oak barks are represented by specimens of the raw and concentrated extract. Of the foreign collections no particular mention can be made. The collections are quite large, however, particularly from South America, and are principally barks, woods, and leaves. From Turkey the department received an interesting series of oak-galls of different kinds, among them the "Aleppo galls" of commerce. Galls are used also for their coloring matter in the manufacture of ink.

GUMS AND RESINS.

Among the examples in this series may be named gum acacia (gum arabic), gum thus or frankincense, gum catechu, gum hyawa (*Icica*

heptaphylla), orore gum (*Pithecolobium hymenæfolium*), gum tragacanth, gum from the "zapote" tree of New Mexico, gum dammar and copal, resin of *Xanthonhea hastialis* and from another species of this genus called "black-boy gum," gum anime (used for incense and to manufacture varnish), algaroba gum, &c. Among the interesting specimens lately received may be mentioned the "kawri gum" of New Zealand. It is used in the manufacture of varnish, and is an important article of commerce. The gum is found, at a depth of two or three feet under ground, over a large area of land which has been exhausted by kawri forests in past ages, and is now barren and almost unfit for cultivation.

Among the lacs or gummy exudations caused by the puncture of insects, from our own country, may be named that from the creosote bush (*Larra mexicana*) and the light-colored opaque gum of the *Opuntia*, both having been received from Arizona and Mexico. A specimen of gum from the *Brosimum galactodendron* has recently been received. The tree belongs to the same family as the bread-fruit tree, and when tapped exudes a thick milky fluid, which flows quite abundantly. It soon ferments, and the gum separates, leaving a liquor or whey which is of no value. It will dissolve in benzine, and when heated to 85° Fahr. it will pull like candy. It has a cheese-like smell when freshly cut, and is nearly white in color, growing darker with age. In Samoa it is used by the natives for filling the seams of their canoes. It has also curative properties, and has been used to a very limited extent in medicine. Several interesting gums and resins have been received from Mexico, under the Mexican names of "coapinole," which sells in the city of Mexico at one dollar a pound; "lechon," "xochicopal," an aromatic resin; "estoraque," used as an incense; "cuajiote," a gum-resin; "archepin," a gum-resin, used as a cement; and "brea," a very useful resin, the result of distillation of the turpentine from *Pinus teocote*, growing in the cold district of Mexico. It is used for making soap and in the manufacture of illuminating gas. "Tacamaca" is a resin, the product of *Elaphrium tomentoso*; "tescalama" is a varnish resin from *Ficus nymphæfolia*; "chicle," the resinous product of *Achras sapota*, is used for chewing, to increase the flow of saliva.

In the old collection of the department there is a small series of gum-resins from the valley of the Amazon, collected by Leuts, Herndon, and Gibbon, in a former expedition, but which are unnamed. Among the elastic gums are specimens of India rubber or caoutchouc, the product of *Ficus elastica*, gutta-percha, and balata, the last named from Venezuela. A new elastic gum from Mexico has received the name Durango caoutchouc. Like the genuine caoutchouc, it hardens with sulphur and receives a fine polish. Specimens of elastic gums from Brazil, and other portions of South America, have been added to the collection, but have not been examined.

FATS, OILS, AND WAX.

There are about half a dozen samples of vegetable tallow and wax in this series. One specimen of the last named, the product of Myrica, jalapensis, is received from Mexico. The vegetable wax of China and Japan (candles of which are shown) is produced from the fruit of several trees belonging to the genus *Rhus*. The most important of these is *Rhus succedanea*, and is grown extensively. *Rhus vernicifera*, the lacquer tree, also yields a wax, differing only in a slight degree from that of the wax-tree mentioned above. *Rhus sylvestris*, or the wild wax-tree, is also worthy of mention. Vegetable tallow is produced in Japan from the *Cinnamomum pedunculatum*. Other specimens of vegetable tallow and

wax are from the valley of the Amazon. The oils are quite numerous, and, where it has been possible to do so, the vegetable products from whence derived are shown with them. Linseed and the more common oils have been received from various countries. The Russian collections included oils of anise, mustard, hempseed, walnuts, sunflower, wild rape, camline seed and poppy, with a few specimens of the refuse or oil cake. Oils of Japan are represented by rape-seed oil, which is used for illuminating purposes (*together with fish oil*) in Japanese households.

The South American collection is quite interesting, and includes "gingelly oil" (*Sesamum indicum*), "cocos oil," from the cocos-palm, "secua oil," (from a cucurbitaceous plant,) Seje oil, from another species of palm, crab oil, from *Carapa guianensis*, ground-nut oil, castor oil, &c. Linseed, ricinus, and cotton-seed oils are shown from our own country, the last named in connection with its principal manufacture, that of soap, a full series of which is shown. A valuable collection of essential oils was purchased for exhibition at Philadelphia, and these have since been added to the museum collections. Among them may be mentioned oils of hemlock, wintergreen, wormwood, golden rod, peppermint, spearmint, sassafras, pennyroyal, bergamot, cedar, oil of neroli, &c., the last named from flowers of *Citrus aurantiacum*, oil of sweet birch (bark of *Betula lenta*), and oil from roots and stems of several species of *Spiræa* are shown. Among the animal products in this subsection are many specimens of beeswax, both native and foreign.

A few animal-fats are also shown from South America; candles and soaps are also included in this group, limited collections of which were received from various localities. The mineral products are represented by series of coal-oils and petroleum, principally from our own country. Specimens of raw and crude paraffine are also exhibited, with some of the products of petroleum, as benzine, naphtha, &c. In this connection may be briefly mentioned a number of specimens of water-proof goods, canvas, leather, wood, &c., rendered so by paraffine in solution. They are impervious to water while freely admitting air.

NATURAL HISTORY SECTION.

About eighty specimens of ducks and chickens were secured for exhibition at the Centennial by the department, in addition to the regular museum collections. These have all been placed on exhibition, making the collection of domestic poultry most complete. Among these may be mentioned thirty-two specimens of a cross between the domestic duck and the wild mallard, purchased from the Smithsonian Institution. Another interesting cross was received a few years ago, said to be between the turkey and the guinea fowl. Other specimens similar to this interesting hybrid have been noted in the district, the department collection containing another specimen very like one mentioned above. It includes nearly all of the well-known varieties or fancy breeds, and as many of them were prize birds of pure breed they are true to name, and may be regarded as types. The collection of pigeons shows many of the fancy breeds of this adjunct of the poultry-yard. Though no new additions have been made to the fine series of small birds beneficial or injurious to agriculture, they have all been relabelled according to the latest authorities, and the specimens themselves brushed up and put in complete order. The poultry, game birds, and small animals have also been plainly relabelled, with both common and scientific names, so that visitors can to a limited extent answer questions for themselves. The col-

lection of economic insects was so fully described in a previous report, further mention will not be necessary.

The fourth section of the museum (D), devoted to forest woods and specimens from the vegetable world purely botanical, is under the charge of the botanist, so cannot be reported upon here.

MISCELLANEOUS COLLECTIONS.

Vegetable substances used in medicine.—This collection, relating to a medical rather than an agricultural museum, is interesting in an economic view, and as many of our common vegetable products are used in medicine, either with the simple preparation of drying in the form of leaves, barks, or other portions of plants, or by resolving them into their approximate principles as quinine, &c., or extracting the medical properties in the form of tinctures or essences, &c., they are therefore given a place especially as they form a part of the vegetable kingdom, and reference is frequently made to them in answering general questions in the museum.

The first series of note in this group is a very valuable collection of specimens of the approximate principles of the following-named plants: *Salicine* from *Salix purpuzea; trilline* from *Trillium pendulum; scrophularine* from *Leptandra virginica; xanthoxyline* from *Xanthoxylum fraxineum; marrubin* from *Marrubium vulgare; gelseminia* from *Gelseminium sempervirens; daturia* from *Datura strammonium; arbutin* from *Arcostaphylos uvaursi; lobelina* from *Lobelia inflata; sanguinaira* from *Sanguinaria canadensis; podophyllin* from *Podophyllum peltatum; jenoia* and *veratroidia* from *Veratrum viride; helenin* from *Inula helenium; celastein* from *Celastrus scandens; phloridzine* from bark of *Pyrus malus; ricinine* from *Ricinus communis; berberina* and *hydrastia* from *Hydrastis canadensis; mannite* from *Leptandra virginica; sanguinaria sulphate* from *Sanguinaria canadensis;* salicylic acid from *Gaultheria procumbens*, and gelsemic acid from *Gelsemium sempervirens.*

In addition to this collection, there are examples of sulphate of quinia, quinidea, and cinchonidia from *cinchona;* sulphate of morphine, narcotine, &c., from the poppy, and many other products of similar nature; these samples are all of American manufacture. A large series of materia medica was received from South America, comprising roots, leaves, barks, and fruits in their unprepared state, with many of their products in the form of extracts, &c. Specimens of medicine are also included, and some of these are interesting, as they are peculiar to the countries presenting them.

SOILS AND FERTILIZERS.

The specimens in these two subsections were collected by the Chemical Division for exhibition at the Centennial. A full description of them was given in the monthly report of the department for May and June, 1876, from which the following statements are made:

> The soils from the geological formations of different ages were collected under the supervision of the State geologist of New Jersey, Professor Cook, and illustrate the character of the soils common to the sections belonging to the several formations represented. The second division of soils, those formed directly from disintegration and decomposition of rocks, consists of a series of virgin soils collected by Professor Berthoud, of Cañon City, Colo., each of which was taken from a large area of known rocks, with no opportunity of admixture with *débris* from breaking down of rocks of a different character. They give a fair representation of the soils which these rocks are capable of producing.
>
> With these specimens are also shown fragments of the rocks from which they

were formed. Collections of marls, including green sand marl and the phosphatic marls from near Charleston, S. C., were made at the same time, and these are exhibited with the other museum specimens of this class.

The vegetable and animal fertilizers consist of muck, peat, marsh-weeds, sea-weeds, cancrine and fish scrap, pork cracklin, dried blood, &c. Specimens of bat excrement are also shown; this fertilizer is found in caves of some of the inland Southern States. The artificial fertilizers, which are made up according to the formulæ of the various manufacturers, from the natural fertilizers enumerated above, next follow.

The method generally employed in this branch of manufacture is illustrated by a series of products taken from different stages of the process as carried on by the Pacific Guano Company. The series consists of specimens of raw rock, the crushed and ground rock, sulphur, niter, and sulphuric acid, the rocks treated with acid, sulphate of ammonia, fish scrap, Stassfurt potash salts, and the mixture of the last four in the finished products.

Another series shows samples of the products put upon the market by different manufacturers.

MODELS OF FARM IMPLEMENTS.

No attempt at an exhibition of objects in this group has ever been made. A few specimens, however, have been received from time to time and placed in the museum. The first to be mentioned are a number of implements sent from China in 1864. Two forms of irrigating machines are shown, the difference being in the mode of applying the power, as one is intended to be run by men and the other by animals. A fan for cleaning grain is also shown, probably an imitation of an American or European fan. Models of smaller implements are also shown, as rakes, hoes, &c. From the Netherlands the department secured a collection of implements (models) used in cheese manufacture, which are very neatly made, and are quite interesting. These comprise all that are at present exhibited in this subsection.

DISEASES OF FARM ANIMALS—CASTS.

Among the contributions to the museum from the Centennial are seventeen anatomical models in plaster, colored from life, of the eyes, throat, digestive organs, &c., as they appear in cattle that died of the rinderpest or cattle-plague in 1867. These models were made and contributed by Dr. A. T. Verhaar, anatomical professor at the government veterinary school at Utrecht, Holland, and will prove of great value should this malignant disease break out in this country.

In conclusion, I would state that when the entire collections of the department are brought together, only a part of which have been briefly mentioned in this report, the museum will be of great value to the department and to the country. Much material was packed away in the store-rooms of the department which should be placed on exhibition, in order that the various collections designated in the classification may be properly catalogued, and that more full and comprehensive reports on the various classes of objects may be made from time to time for publication and dissemination for the information of the people.

TOWNEND GLOVER,
Entomologist and Curator of the Museum.

To Hon. WM. G. LE DUC,
Commissioner of Agriculture.

REPORT OF THE STATISTICIAN.

CROP ESTIMATES OF 1877.

CORN.

SIR: I present herewith my thirteenth annual report as Statistician: Eight crops of maize have been grown since that of 1869, reported by the census, which was a small one, and of these only two, at the commencement of the present period of monetary depression, those of 1873 and 1874 (23.8 and 20.7 bushels per acre, respectively), have been much below the average in yield. The average estimated yield of these eight crops is 26.7; that of the past, which is nearest of all to this average year, 26.6. The first three of the series were above this figure, and the past three crops range from 26.1 in 1876 to 29.4 in 1875. With the increase in area the aggregate quantity of either of these crops is greater than any crop prior to 1875.

The average prices of these years attest the verity and measure of these fluctuations. There has been a tendency to depression of all values, becoming more active since 1872, which must be taken into consideration in tracing the effect of production upon value. Of late there has been in operation an opposing tendency to higher prices, in the increased demand caused by enlargement of exports of beef and pork products, and the extension of both the fresh and live meat trade, which has prevented the utter breaking down of prices by three large crops in succession.

The large crops following that of 1869 caused a continuous decline in price; first from 54.9 cents to 48.2, and next to 39.8. The poor crops following compelled a rise to 48, and then to 64.7 cents. Then the product rose in 1875 to 1,321 from 850 million bushels, and the price fell to 42 cents. The increase of 55 per cent. in product supplied the current deficiency and at once reduced the price to 35.8 cents. The full effect of this crop, with the surplus added to one following nearly as large, was seen in a further reduction to 37 cents, or 45 per cent. decrease from the price of 1874. Here the bottom is reached, for the further decline of 12 mills per bushel is only in proportion to the small increase in product. The tendency in the future will be toward a gradual increase in price as the wants of increasing population and foreign demand, not so much for raw corn as for its secondary products, press upon facilities for production. And yet, if manufacturing industry does not revive, and surplus labor shall go largely into competition with grain-growers, there is yet land enough for a production that may depress still further the value of corn. This is a contingency which, for the prosperity of the American people generally, it is hoped may not arise.

The study of the philosophy of prices of this cereal during this period is facilitated by a calculation of the yearly supply *per capita*, and a division into subperiods, as follows:

Year.	Bushels.	Value.	Year.	Bushels.	Value.	Year.	Bushels.	Value.
1870	28.4	54.9	1873	22.3	48	1876	28.3	37
1871	25.1	48.2	1874	19.9	64.7	1877	28.9	35.8
1872	27	39.8	1875	30	42			

From 1870 to 1872 prices fell rapidly from the high rate of 1869, as a result both of abundant supplies and a general shrinkage of values.

When the supply *per capita* fell to less than 20 bushels in 1874, the price rose to 64.7 cents, while a subsequent supply of nearly 29 bushels brought the price within 36 cents.

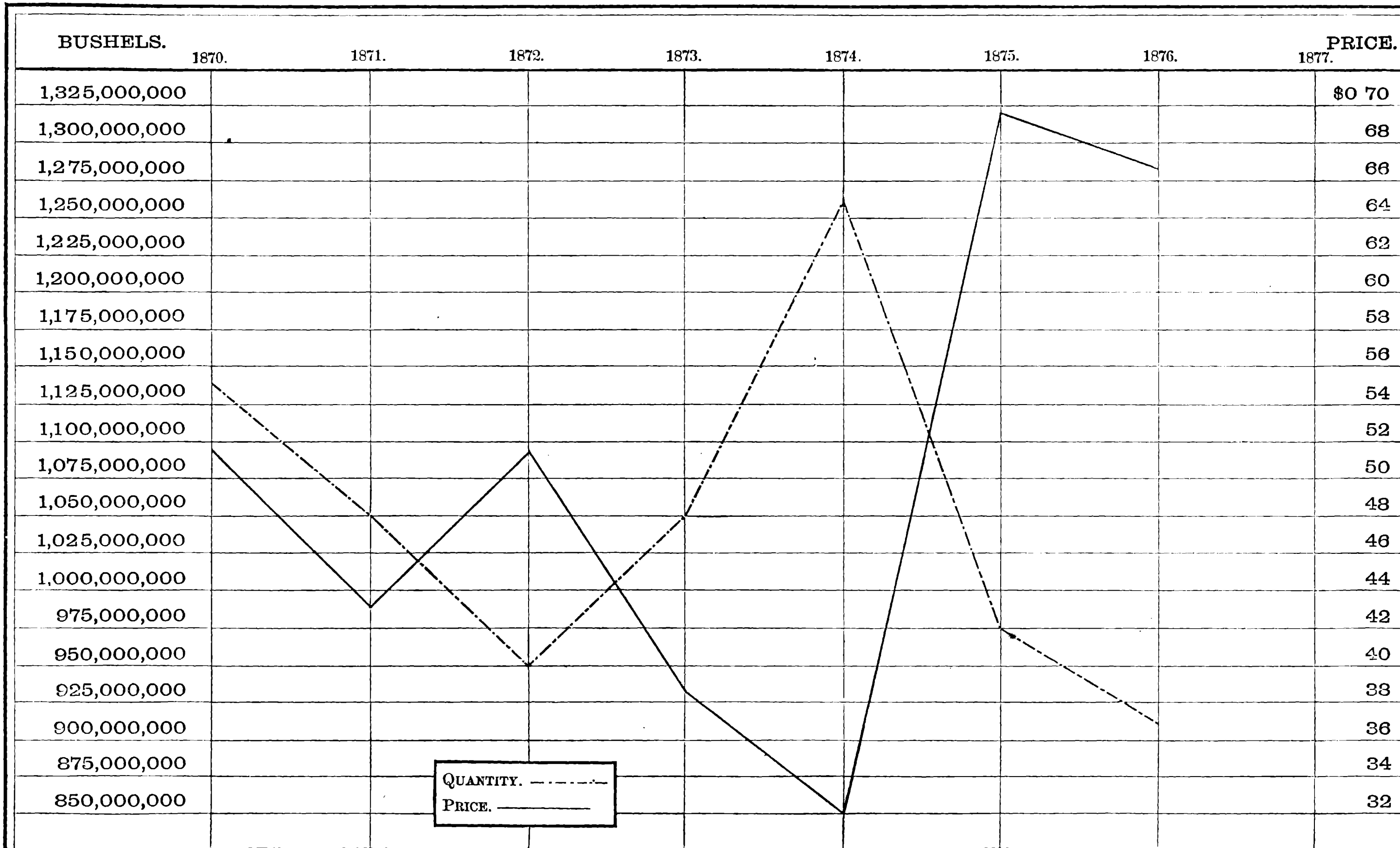
There is to the farmer a consolation in the law of compensation involved in the effect of quantity upon value in production. In the years of low production the value of each acre of corn was greater than in the following years of plenty. The increase in 1875 of fifty-five per cent. produced only one per cent. increase of aggregate value. The following table presents the aggregate quantity, area and value, and the average of yield and value per acre, and price per bushel, for the past eight years, in accordance with the estimates for each year:

Years.	Bushels.	Acres.	Value.	Yield.	Price.	Value per acre.
1870	1,094,255,000	38,646,977	$601,839,030	28.3+	$0 54.9+	$15 57
1871	991,898,000	34,091,137	478,275,900	29.1−	48.2+	14 02
1872	1,092,719,000	35,526,836	435,149,290	30.7+	39.8+	12 24
1873	932,274,000	39,197,148	447,183,020	23.8−	48.0−	11 41
1874	850,148,500	41,036,918	550,043,080	20.7+	64.7−	13 40
1875	1,321,069,000	44,841,371	555,445,930	29.4+	42.0+	12 38
1876	1,283,827,500	49,033,364	475,491,210	26.1+	37.0+	9 69
1877	1,342,558,000	50,369,113	480,643,400	26.6+	35.8+	9 54
Total	8,908,749,000	332,742,864	4,024,070,860			
Average	1,113,593,625	41,592,858	503,008,857	26.7+	45.1+	12 09

It is assumed by some political economists that the foreign value of an exported product fixes its price for home consumption. This is not true of corn, or of anything else, except as exportation affects the equilibrium of supply and demand. In this case the exportation of from three to five per cent. of the crop is too small an element in demand to affect very sensibly the price. The foreign need of our live beeves, fresh beef and mutton, salt beef and pork, lard, cheese, and butter, is exercising a much greater effect in appreciating price. As the element of foreign demand is of minor importance, the home price is almost in exact proportion to quantity produced, due allowance being made for scarcity or abundance of other feeding material which may be in part a substitue for corn, and for fluctuations in general values or other extraneous cause of differences. This is shown more clearly by the accompanying diagram, which represents the quantity in bushels and average price per bushel of each crop since 1869, the lines of quantity and value crossing each other with each fluctuation. Had the number of bushels *per capita* been the same during the entire period, the decline would have been very gradual, corresponding with the shrinkage of values, except that the tendency to fall would be slightly checked by the increase of the exports of the various products of maize. Thus, while in the first three years of plenty the decline was from 54.9 to 39.8 cents, in the latter it was from 42 to 35.8 cents, due mostly to general shrinkage of values.

In the early returns of the crop of 1877 there was much complaint of late planting; of slow growth in the West on account of an excess of rain; of low temperature in the Middle States, and of effects of wet weather on the Southern Atlantic coast. The replanting of wet areas in Illinois and Indiana was followed by good growth in June, checked only by rank luxuriance of weeds, difficult to keep under until the fine weather of July had fortified the crop against ordinary possibilities of destruction. Improvement was generally noted in July, with the exception of some injury from drought in the eastern portion of the cotton belt, and from heavy rains in some portions of Mississippi and the eastern part of Texas. A considerable area was destroyed by the overflow of the Arkansas,

DIAGRAM I.



Quantity and Value of Corn since 1870.

M. JOYCE, WASHINGTON

much of which was replanted either in cotton or corn. In August there were some southern districts in which drought was more or less severe and others in which rains were injuriously heavy, and in portions of the West there was some loss from grasshoppers and chinches, yet the general tenor of reports was favorable. The average of condition was 92 in August, and was remarkably well sustained in September at 91. In the crop report for August the following comparison of condition was made:

As compared with the great crops of 1870 and 1872, when the estimates of yield were 28.3 and 30.7 bushels per acre, condition is now lower than in August of the latter year, but nearly as high as in 1870. Unless the crop should be cut down by frost, or the earing be disproportionate to the development of the stalk, these figures would indicate a yield of 27 bushels, which would give an aggregate exceeding 1,350,000,000 bushels, the largest aggregate in quantity ever recorded, but not the greatest yield per acre. This is not given as a prediction, but as a fair rendering of the returns of the season up to the present time, subject to future contingencies.

And yet it proved a remarkably close prediction. There was no frost or other cause of marked deficiency. The sum of local estimates, which were wrought out in detail from results of all the returns of the year, came within half of one per cent. of the aggregate named, and the yield per acre was 26.6.

WHEAT.

As the real status of corn production was obscured in the public mind by the fact that the census returns did not represent a year of full yield, so the average wheat supply was made to appear too large by the returns of a season of unusual abundance. The fact was made manifest to the initiated long before the census returns were tabulated, but the masses did not realize that the crop of 1869 was one-eighth larger than an average and that such average crop would have been but 256 millions instead of 287 millions of bushels. A view of this fact is essential to a proper understanding of the real advance made in eight years.

The department average of yield for 1869 was 13.5, a figure since exceeded only by that of 1877, which is 13.9. The highest yield of this period therefore followed the lowest, 10.4 bushels in 1876, which is the lowest of the recorded averages of the department, with the sole exception of that of 1866 (9.86 bushels), a year of disaster, when Ohio did not produce enough bread for her own people. Thus the range of yield between our best and worst crops is only about four bushels, or from ten to fourteen. Between the years of large yields, 1869 and 1877, the widest difference in seven successive crops was but 2.3 bushels, from 10.4 in 1876 to 12.7 in 1873.

The difference in the supply *per capita* has ranged in this period from 5.84 to 7.72 bushels, and the portion of this exported has ranged from less than one bushel to more than two. It is desirable to have five bushels for a full supply for bread, though four and a half may be ample in a season of high prices, one bushel for seed, and our average export requires about one and a half bushels. Seven bushels *per capita* will therefore suffice, at the present time, for a surplus for export of 72 million bushels. Our years of heaviest export are those of 1874 and 1877, when our supply *per capita* has been largest. That supply and the home prices have been as follows:

Year.	Per capita.	Price.	Year.	Per capita.	Price.
1870	6.12	$1 04	1874	7.19	$0 94
1871	5.84	1 25	1875	6.63	1 00
1872	6.16	1 24	1876	6.39	1 03
1873	6.74	1 18	1877	7.72	1 08

The foreign demand is with wheat an important element in fixing the price, as nearly one-fourth of the crop goes abroad. In the past year, in the face of the heaviest crop known, the rate was slightly advanced by increase of such demand.

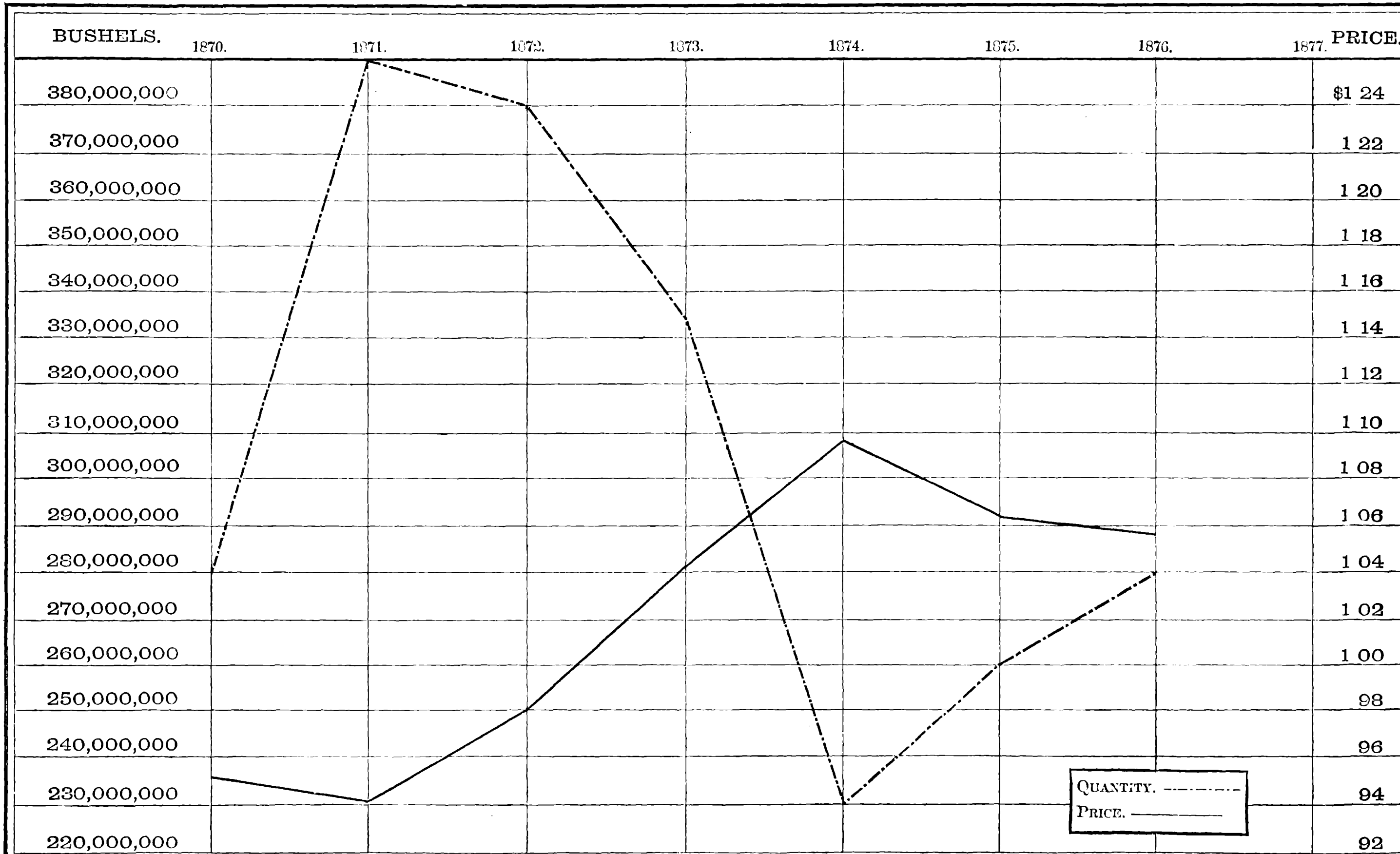
The estimated area, product, value, yield and value per acre, and price per bushel, are as follows for the past eight years:

Years.	Bushels.	Acres.	Value.	Yield.	Price.	Value per acre.
1870	235, 884, 700	18, 992, 591	$245, 865, 045	12. 4+	$1 04. 2+	$12 94
1871	230, 722, 400	19, 943, 893	290, 411, 820	11. 5+	1 25. 8+	14 56
1872	249, 997, 100	20, 858, 359	310, 180, 375	11. 9+	1 24. 0+	14 87
1873	281, 254, 700	22, 171, 676	323, 594, 805	12. 7−	1 15. 0+	14 59
1874	308, 102, 700	24, 967, 027	291, 107, 895	12. 3+	94. 4+	11 66
1875	292, 136, 000	26, 381, 512	294, 580, 990	11. 0+	1 00. 0+	11 16
1876	289, 356, 500	27, 627, 021	300, 259, 300	10. 4+	1 03. 7+	10 86
1877	365, 094, 800	26, 193, 407	395, 155, 375	13. 9+	1 08. 2+	15 08
Total	2, 252, 548, 900	187, 135, 486	2, 451, 155, 605	....	....	....
Average	281, 743, 612	23, 391, 936	306, 394, 451	12. 0+	1 08. 8−	13 09

The course of prices, in connection with the annual range of production, is illustrated by Diagram 2. The abrupt rise at 1871 is due to the fact that the wheat supply per man was less that year than in any for the past ten. The annual product continued to augment till 1874, and the price kept its retrograde to the same date. The poor crops of Great Britain for the past three years have caused a small advance in price, even for 1877, in which production has outstripped that of any former year. Diagram 3, which shows the remarkable rise and subsequent fall in London prices dependent on the exigencies of the Russo-Turkish war, also explains the increase in our average home prices for the last year's crop.

The record of the wheat crop of the past year accords with the accepted result of the harvest; the season, from seeding to reaping, was bright with unusual promise in comparison with former years. In the two years immediately preceding, the first reports of spring were shaded with forebodings of loss from freezing and thawing, which the subsequent very favorable weather could not entirely relieve, as the result showed a yield below average in both cases; but the spring of 1877 was exceptionally exempt from all causes of depreciated condition. The April returns of winter wheat included 868 counties, in 650 of which a condition varying from average to superior thrift was indicated. The injury from frost was an inconsiderable factor in condition even in the more northern belt. Six-sevenths of all the counties of the Ohio valley reported more than medium prospects. It was only a little less favorable in Missouri and Kansas. The presence of the locust (the terrible *Caloptenus spretus*) was indicated in twenty-two of the thirty-eight counties in Kansas reported, but fears of anticipated ravages soon subsided, and the locusts themselves disappeared, in part by the aid of man, but mainly from natural causes. Later returns from the spring-wheat region, in certain districts of which locusts had deposited their eggs in immense numbers, showed that in Kansas, Nebraska, and Iowa a portion of the ova had been destroyed, while the young brood hatched possessed an enfeebled vitality, or were destroyed by parasites or by the ingenious appliances and persistent efforts of man, with such success that in few localities occurred any serious reduction of the very general and remarkable vigor of growth which characterized the plant throughout the entire spring-wheat region. In June the record

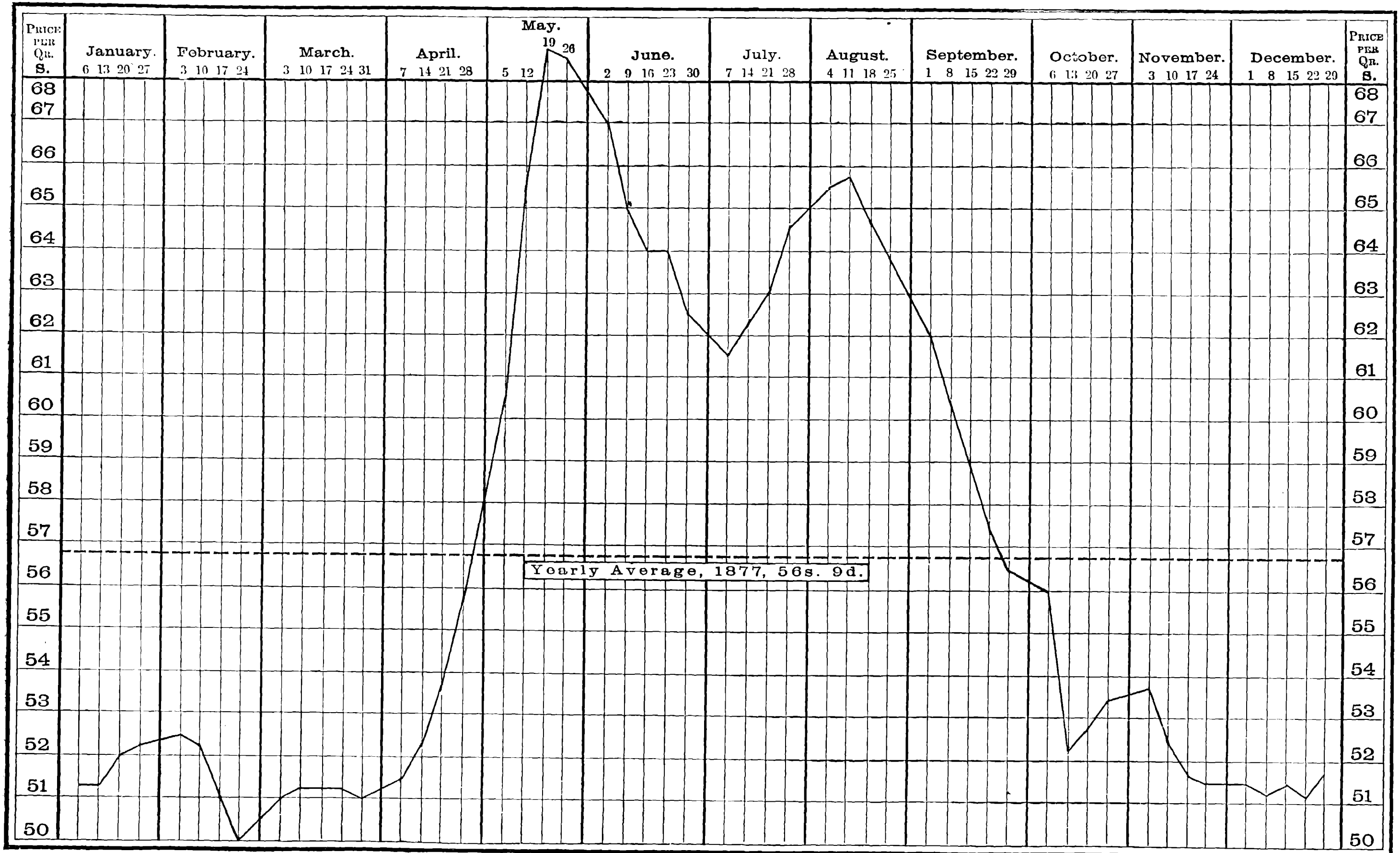
DIAGRAM II.



Quantity and Value of Wheat since 1870.

M. JOYCE, WASHINGTON.

DIAGRAM III.



Fluctuations of London Prices of Wheat in 1877.

M. JOYCE, WASHINGTON.

of condition stood higher in nearly all the States than in previous years; and this promise was sustained in July in the more northern States in which the crop had not been harvested. There were fewer indications of rural discontent than usual, and signs of grumbling were rare and faint. Of course there were instances of injury, as there ever must be, from such causes as the Hessian fly, locusts, rust, smut, winter-killing, and other ills to which wheat is heir.

The final record not only of the largest crop, but of the heaviest yield per acre of the past ten years, was in strict accordance with the crop history of the entire season.

OATS.

The yield of oats was larger in 1877 than in any of the past ten years, and the aggregate quantity greater, though the acreage was less than in 1876. In the South the crop was better in quantity and quality than for many years. The average yield for eight years has been 1.2 bushels higher than the average for corn.

There is a degree of parallelism between the prices of corn and oats. In the years of average crops, both of corn and oats, the price of oats is about four-fifths that of corn. In the years of scarcity of corn, as in 1873, the proportion was little more than three-fourths; but in 1874, with poor yields of both crops, the proportion was four-fifths again, or 52 to 64.7 cents. In 1875, with 30 bushels of corn to each unit of population, the largest proportionate supply of any of the past ten years, the price of oats was seven-eighths that of corn. In 1876, with a low yield of oats and a good supply of corn, the figures were 35.1 and 37 cents respectively; and in the last year, with a large supply of both crops, and prices of both very low, the normal relation of four-fifths is again reached. While this is the relation of the two crops for the whole nation, the different sections of the country accord different degrees of prominence to these crops. It often occurs, for instance, that in the South oats command a higher price than corn; in the East the proportion is often about six to ten, as the climate is better suited to oats than corn. The following list of prices in States representing sections will illustrate this difference:

States.	1872.		1874.		1876.		1877.	
	Corn.	Oats.	Corn.	Oats.	Corn.	Oats.	Corn.	Oats.
Maine	94	50	113	67	79	49	78	45
New York	70	44	93	57	68	42	60	35
Maryland	57	40	73	55	49	31	53	32
Georgia	86	83	92	88	60	68	68	65
Texas	43	81	75	84	50	58	43	46
Tennessee	48	42	68	57	32	39	40	40
Ohio	34	29	58	49	38	31	40	28
Illinois	24	19	56	45	31	26	29	22
Missouri	36	26	51	44	40	37	38	31
Kansas	22	22	91	53	24	22	21	18

The first of the years taken, 1872, was one of overflowing supply and low prices; 1874 a year in which both crops were small and prices high (see price of corn in Kansas in a year of great scarcity); 1876, corn more abundant than oats; 1877, both very abundant crops.

A consolidation of local estimates of recent years presents the following summary:

Years.	Bushels.	Acres.	Value.	Yield.	Price.	Value per acre.
1870	247, 277, 400	8, 792, 395	$107, 136, 710	28. 1+	$0 43. 3+	$12 18
1871	255, 743, 000	8, 365, 809	102, 570, 030	30. 5+	40. 1+	12 26
1872	271, 747, 000	9, 000, 769	91, 315, 710	30. 1+	33. 6+	10 14
1873	270, 340, 000	9, 751, 700	101, 175, 750	27. 7+	37. 4+	10 37
1874	240, 369, 000	10, 897, 412	125, 047, 530	22. 0+	52. 0+	11 47
1875	354, 317, 500	11, 915, 075	129, 499, 930	29. 7+	36. 5+	10 86
1876	320, 884, 000	13, 358, 908	112, 865, 900	24. 0+	35. 1+	8 44
1877	406, 394, 000	12, 826, 148	118, 661, 550	31. 6	29. 2	9 25
Total	2, 367, 071, 900	84, 908, 216	888, 273, 110			
Average	295, 883, 987	10, 613, 527	111, 034, 129	27. 9	37. 5	10 46

BARLEY.

The season was favorable to barley, except in California, where the crop was much reduced. The later returns were generally more cheerful than those of June.

The record of the yield of barley for a series of years, indicates a rate of production at least seventy-five per cent. greater than that of wheat, and much larger valuation of product per acre. The difference is doubtless increased by a careful selection of suitable soils for barley, which occupies limited areas. The estimates are:

Years.	Bushels.	Acres.	Value.	Yield.	Price.	Value per acre.
1870	26, 295, 400	1, 108, 924	$22, 244, 584	23. 7+	$0 84. 5+	$20 05
1871	26, 718, 500	1, 177, 666	21, 541, 777	22. 6+	80. 6+	18 29
1872	26, 846, 400	1, 397, 082	19, 837, 773	19. 2+	73. 8+	14 19
1873	32, 044, 491	1, 387, 106	29, 333, 529	23. 1+	91. 5+	21 15
1874	32, 552, 500	1, 580, 626	29, 983, 769	20. 6−	92. 1+	18 96
1875	36, 908, 600	1, 789, 902	29, 952, 082	20. 6+	81. 1+	16 73
1876	38, 710, 500	1, 766, 511	25, 735, 110	21. 9+	66. 4+	14 56
1877	34, 441, 400	1, 614, 654	22, 028, 644	21. 3	63. 9+	13 64
Total	254, 517, 791	11, 822, 471	200, 657, 268			
Average	31, 814, 724	1, 477, 809	25, 082, 158	21. 5+	78. 8+	16 97+

RYE.

The average rate of yield for rye is slightly higher than that of wheat, but the price is materially lower, making a smaller pecuniary return per acre. It is generally grown on less valuable land than that devoted to wheat. It is a minor crop, not increasing materially in importance, except in the South, where it is cultivated mainly for winter pasture. The crop of last year, like that of wheat, maintained a high condition and resulted in a large yield, as the following table shows:

Years.	Bushels.	Acres.	Value.	Yield.	Price.	Value per acre.
1870	15, 473, 600	1, 176, 137	$12, 612, 605	13. 1+	$0 81. 5+	$10 72
1871	15, 365, 500	1, 069, 531	12, 145, 646	14. 3+	79. 0+	11 35
1872	14, 888, 600	1, 048, 654	11, 363, 693	14. 1+	76. 3+	10 83
1873	15, 142, 000	1, 150, 355	11, 548, 126	13. 1+	76. 2+	10 04
1874	14, 990, 900	1, 116, 716	12, 870, 411	13. 4+	85. 8+	11 52
1875	17, 722, 100	1, 359, 788	13, 631, 900	13. 0+	76. 9+	10 02
1876	20, 374, 800	1, 468, 374	13, 635, 826	13. 8+	66. 9+	9 28
1877	21, 170, 100	1, 412, 902	12, 542, 895	14. 9+	59. 2+	8 87
Total	135, 127, 600	9, 802, 457	100, 351, 102			
Average	16, 890, 950	1, 225, 307	12, 543, 888	14. 9+	59. 2+	8. 87

BUCKWHEAT.

Nearly two-thirds of the crop is annually produced in New York and Pennsylvania to meet the winter demand for buckwheat flour in the seaboard cities. The area in buckwheat is small, and not very rapidly extending. The yield of last year was comparatively small, as shown in the following statement:

Years.	Bushels.	Acres.	Value.	Yield.	Price.	Value per acre.
1870	9,841,500	536,992	$7,725,044	18.3+	$0 78.4+	$14 38
1871	8,328,700	413,915	6,900,268	20.1+	82.8+	16 67
1872	8,133,500	448,497	6,747,618	18.1+	82.9+	15 04
1873	7,837,700	454,152	6,382,043	17.2+	81.4+	14 05
1874	8,016,600	452,590	6,477,885	17.7+	80.8+	14 31
1875	10,082,100	575,530	7,166,267	17.5+	71.0+	12 45
1876	9,668,800	666,441	7,021,498	14.5+	72.6+	10 53
1877	10,177,000	649,923	6,998,810	15.6+	68.7+	10 76
Total	72,085,900	4,198,040	55,419,433			
Average	9,010,737	524,755	6,927,429	17.1−	76.8+	13 20

POTATOES.

The conditions for a good crop were more favorable than for many years, excepting only 1875, when a plethora of Irish potatoes existed in all sections to which they are suited. The Colorado beetle, although still demonstrating in the West, is now little feared there; in New England the pest was more troublesome, but was generally subdued by hand-picking, the application of Paris green to a limited extent, and other methods of warfare. In some portions of Tennessee the beetle was very destructive. The highest condition was reported in Vermont, New Jersey, New York, Pennsylvania, Ohio, Michigan, Indiana, and Illinois.

The most disastrous season in many years was that of 1876, when the average yield was estimated at 71.6 bushels per acre, against 110.5 the previous year. In former years of low condition the general average has scarcely been below 80, and the average for eight years past has been 88.7 bushels. The prices have ranged from 38.9 cents in 1875 to 72 in 1870. In 1876, while yield per acre was lowest, the acreage was large, and the price, 65.5, was not so high as in 1870 or 1873, when the aggregate quantity of the crop was less. The supply varies from 2.25 bushels to 3.8 for each unit of population. To bring the price down below 50 cents per bushel, there must be a close approximation to 3.5 bushels for each individual.

Years.	Bushels.	Acres.	Value.	Yield.	Price.	Value per acre.
1870	114,775,000	1,325,119	$82,668,590	86.6+	$0 72.0+	$62 38
1871	120,461,700	1,220,912	71,836,671	98.6+	59.6+	58 83
1872	113,516,000	1,331,331	68,091,120	85.2+	59.9+	51 14
1873	106,089,000	1,295,139	74,774,890	81.9+	70.5−	57 73
1874	105,981,000	1,310,041	71,823,330	80.9−	67.7+	54 82
1875	166,877,000	1,510,041	65,019,420	110.5+	38.9+	43 05
1876	124,827,000	1,741,983	83,861,390	71.6+	65.5+	48 14
1877	170,092,000	1,792,287	76,249,500	94.9	44.8+	42 54
Total	1,022,618,700	11,526,853	594,324,910			
Average	127,827,337	1,440,856	74,290,614	88.7+	58.1+	52 04

COTTON.

An estimated increase of breadth of between three and four per cent. was made in 1867. The increase is thus given by States:

States.	1876.	1877.	
	Acres.	*Per cent.*	*Acres.*
North Carolina	609,000	96	584,640
South Carolina	945,500	97	917,135
Georgia	1,515,000	96	1,454,400
Florida	165,000	101	166,650
Alabama	1,732,250	102	1,766,895
Mississippi	1,976,000	104	2,055,040
Louisiana	1,260,000	106	1,335,600
Texas	1,483,500	115	1,706,025
Arkansas	1,133,000	105	1,189,650
Tennessee	741,000	102	755,820
Indian Territory, &c	117,000	107	125,000
Total	11,677,250	103.3	12,056,855

In June the condition of the plant was lower than at that period in the two previous years, but higher than 1874. The weather had been too wet at the time of planting, too cool afterward, and then too dry in the region east of the Mississippi. Later in June there was an excess of rain in the northern belt. At the 1st of July the crop was at least a week late. It was making rapid improvement, and the general average was 93.4 per cent., which was 4 per cent. less than in 1876, but 7 per cent. higher than in 1873 or 1874. In Texas there had been an unusual amount of rain. An overflow in the Arkansas submerged sixty thousand acres, which were mostly replanted either in corn or cotton.

Insects were not especially injurious, though reported casually in many places. The cut worm and aphides were first reported, and the caterpillar to commence depredations before the 1st of July in Southern Texas. In August the general average of condition was 93, a fact indicative of an unusual harvest, as the record for that month is almost always lower than that of July. The States of heaviest production were those exhibiting high condition. The only adverse circumstance worthy of any serious consideration was the increase of the caterpillar in Texas, and in minor degree in Louisiana and farther east. The loss from cotton-worms is estimated at $15,000,000.

The season continued very favorable for perfecting the middle and top crops, and for picking. The result was the largest crop ever produced in the United States. The crop movement is not complete, but enough is known to assure a completed record of at least 3¾ million bales.

HAY.

The hay crop of 1877 was abundant in quantity in most of the States The most noticeable exception was the crop of California, which was about two-thirds of a full crop, on account of the severity of the drought. Condition ranged high in the States north of the 36th parallel, with the exception of some depreciation from drought in Maine, Vermont, Michigan, and Wisconsin, and from locusts in parts of Minnesota. In the Carolinas and in the Gulf States, and in Tennessee, the product was somewhat reduced. A large crop was harvested in the States from New York to Virginia and in the West and Southwest, with the exceptions noted above. The product for last year is estimated at 31,629,300 tons, cut from 25,367,708 acres, and valued at $271,934,950.

WESTERN MOVEMENT OF WHEAT AND CORN GROWING.

While it is true that centers of production of both wheat and corn are moving rapidly westward, and that the quantity produced in proportion to population is decreasing in some of the older and more eastern States, there is great difference in the rate of decrease in different sections. In presenting the several groups of States, New York is classed with New Jersey and Pennsylvania as the North Middle States, and Delaware is placed with Maryland and Virginia as the South Middle. By groups the product of wheat *per capita* is thus presented:

States.	1849.	1859.	1869.	1877.
New England	.40	.34	.28	.30
North Middle	5.10	3.15	3.87	3.38
South Middle	7.72	8.41	6.43	7.58
Southern Atlantic	1.69	2.96	1.83	2.84
Southern	.69	2.11	1.70	3.27
Ohio Valley	7.53	10.79	12.77	10.90
Trans-Mississippi	5.12	7.02	11.47	20.04
Pacific	2.16	15.38	27.73	27.49

The first three are the crops reported by the census and consumed in the census years, and the calculation is therefore made upon the enumerated population of those years.

From 1850 to 1860 there was an increased production in the South and West, and a decrease in the northern Atlantic States. In the next decade there was a decrease in the South, on account of the assumed necessity of a large cotton crop, the money crop of that region, a further decrease in the East, a slight advance in the Middle States, a continued increase in the Ohio Valley, and a greater advance west of the Mississippi. The eastern, north middle, and southern groups do not supply their home demand; the South Middle States have a small surplus, the Ohio Valley has a surplus of nearly half their crop, and the more western groups produce more than a three-fold supply of the home demand.

Making three great divisions, including in the first the Atlantic States with Pennsylvania and West Virginia, and allowing the Mississippi to constitute the line of division between the second and third, it is found that the actual quantity produced, without reference to supply per head of population, has not declined, but has constantly advanced, though with very unequal steps, as seen in the following table:

Sections.	1849.	1859.	1869.	1877.
Atlantic coast ..... bushels..	51,657,020	53,294,137	57,476,371	64,344,800
Central belt ..... do....	43,522,646	94,458,609	140,877,070	147,890,000
Trans-Mississippi ..... do....	5,306,278	25,352,178	89,392,185	152,860,000
Total	100,485,944	173,104,924	287,745,626	365,094,800

The increase of production in proportion to population has advanced from 4.33 bushels per head in 1849 to 7.87 bushels in 1877. From 1859 to 1869 the increase was from 5.5 to 7.28 bushels. The proportions of 1869 and 1877 were larger by at least one bushel on account of more than average yield in those years.

The percentages of each crop produced in these sections of the dates indicated are:

Sections.	1849.	1859.	1869.	1877.
Atlantic coast	51.4	30.7	20	17.6
Central belt	43.3	54.6	49	40.5
Trans-Mississippi	5.3	14.7	31	41.9
	100	100	100	100

Diagram 4 shows the progress of the movement of wheat and corn production westward, longitudinal lines dividing the areas producing equal volumes of the crops of the four periods named.

The wheat crop of 1849 was 100,485,944 bushels, divided into equal volume by the line of 81° west of Greenwich.

In 1859, 173,104,924 bushels; center of production advanced to 85° 24′.

In 1869, 287,745,626 bushels; central line 88°.

In 1877, 365,094,800 bushels; center of production, 89° 6′.

The corn crop of 1849 was 592,071,104 bushels; production was divided into equal volumes by the 85th degree of west longitude.

In 1859, 838,792,742 bushels; center of production, 86° 30′.

In 1869, 760,944,549 bushels; center, 88°.

In 1877, 1,342,558,000 bushels; central line, 89° 6′.

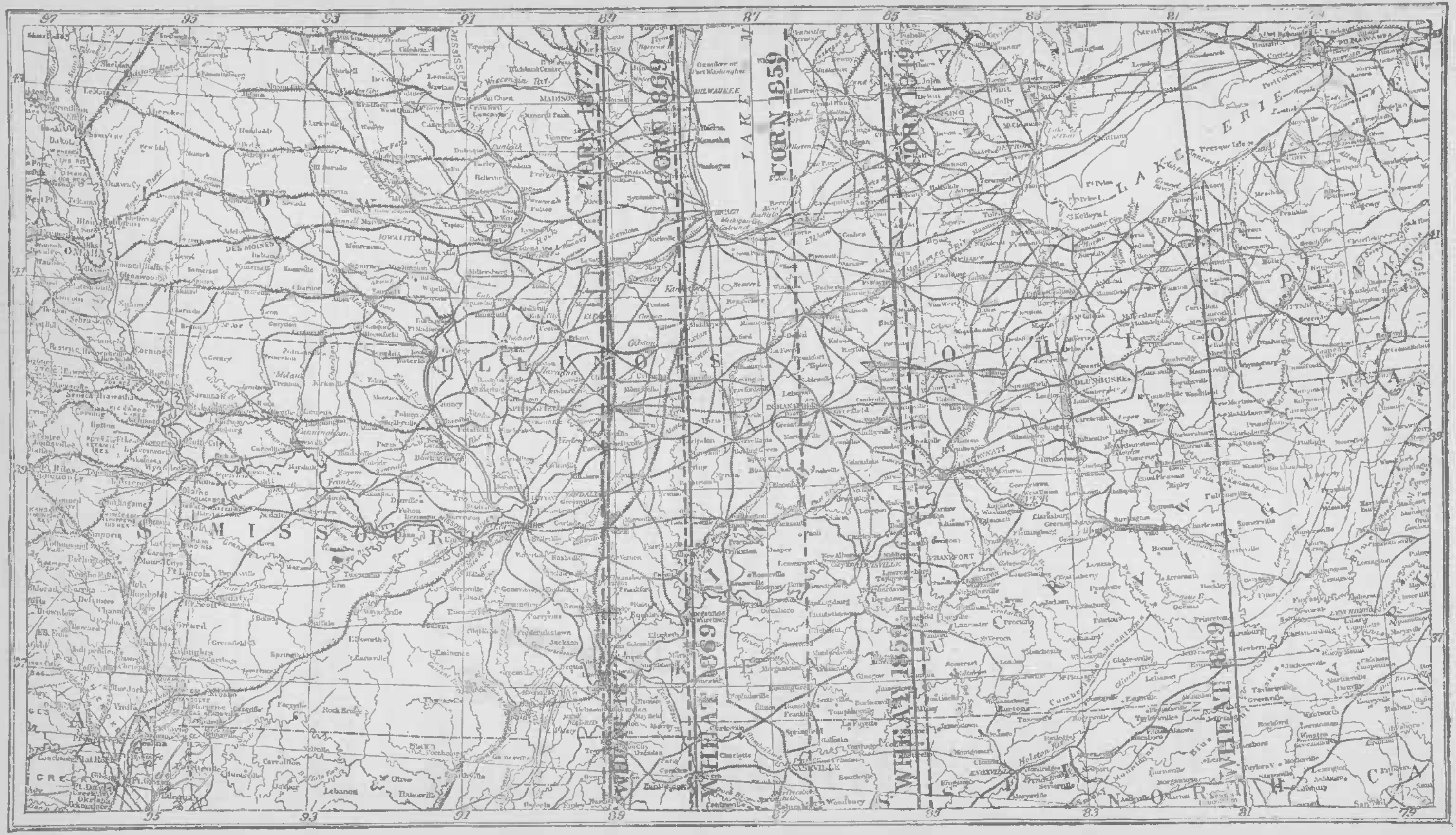
In twenty-eight years the movement westward has been—for wheat, 8° 6′, or from the eastern line of Ohio nearly to the center of Illinois; for corn, 4° 6′, or from the eastern line of counties in Indiana nearly to the longitude of Cairo. The rate of movement is necessarily slow of late, little more than one degree in eight years, and for corn may be still slower in the future, as the heaviest portion of the Illinois production is still west of this line, and Illinois produces one-fifth of the national crop. The progress of wheat-growing westward, over large areas of the plains and plateaus and mountain valleys between Western Nebraska and the Pacific coast, must eventually carry the central line for wheat much beyond that of corn.

The percentage of the whole crop produced in the three divisions named has been as follows at the dates specified:

Sections.	1849.	1859.	1869.	1877.
Atlantic coast	30	24	20	14
Central belt	58	55	53	49
Trans-Mississippi	12	21	27	37
	100	100	100	100

Thus the Atlantic coast proportion of the whole production has declined more than one-half, that of the central belt one-fifth, while that of the region beyond the Mississippi has trebled. Twenty-eight years ago the product of the far West was but two-fifths of the crop of the Atlantic coast; now it is more than double. The central belt exceeded the combined proportions of both others until 1877.

DIAGRAM IV.



WHEAT ——— CORN --------

Table showing the product of each principal crop of the several States named, the yield per acre, the total acreage, the average price in each State, and the value of each crop for 1877.

Products.	Quantity produced in 1877.	Average yield per acre.	Number of acres in each crop.	Value per bushel or ton.	Total valuation.
MAINE.					
Indian corn .... bushels..	1,680,000	36	46,667	$0 78	$1,310,400
Wheat .... do...	350,000	14	25,000	1 60	560,000
Rye .... do...	37,000	14	2,643	1 00	37,000
Oats .... do...	2,412,000	23	104,869	45	1,085,400
Barley .... do...	650,000	17.5	37,143	76	494,000
Buckwheat .... do...	400,000	22	18,182	59	236,000
Potatoes .... do...	7,000,000	100	70,000	46	3,220,000
Hay .... tons..	1,138,000	.90	1,264,444	12 50	14,225,000
Total	....	....	1,568,948	....	21,167,800
NEW HAMPSHIRE.					
Indian corn .... bushels..	2,400,000	42.5	56,470	79	1,896,000
Wheat .... do...	220,000	17	12,941	1 60	352,000
Rye .... do...	49,000	15	3,267	92	45,080
Oats .... do...	1,550,000	43	36,046	43	666,500
Barley .... do...	110,000	23	4,782	75	82,500
Buckwheat .... do...	96,000	18	5,333	55	52,800
Potatoes .... do...	4,480,000	112	40,000	50	2,240,000
Hay .... tons..	715,000	1.10	650,000	11 80	8,437,000
Total	....	....	808,839	....	13,771,880
VERMONT.					
Indian corn .... bushels..	2,150,000	39	55,128	77	1,655,500
Wheat .... do...	550,000	19	28,947	1 45	797,500
Rye .... do...	82,000	17.5	4,686	86	70,520
Oats .... do...	4,850,000	39	124,359	42	2,037,000
Barley .... do...	130,000	26	5,000	85	110,500
Buckwheat .... do...	405,000	22	18,409	60	243,000
Potatoes .... do...	5,780,000	130	44,461	40	2,312,000
Hay .... tons..	1,050,000	.98	1,071,428	10 10	10,605,000
Total	....	....	1,352,418	....	17,831,020
MASSACHUSETTS.					
Indian corn .... bushels..	1,250,000	34.7	36,023	70	875,000
Wheat .... do...	18,300	22	832	1 50	27,450
Rye .... do...	348,000	14	24,857	78	271,440
Oats .... do...	580,000	35	16,571	51	295,800
Barley .... do...	60,000	24	2,500	87	52,200
Buckwheat .... do...	49,000	14	3,500	77	37,730
Potatoes .... do...	3,415,000	105	32,524	60	2,049,000
Hay .... tons..	665,000	1	665,000	15 20	10,108,000
Total	....	....	781,807	....	13,716,620
RHODE ISLAND.					
Indian corn .... bushels..	270,000	33	8,182	84	226,800
Wheat .... do...	....	....	....	....	....
Rye .... do...	22,000	15	1,467	89	19,580
Oats .... do...	127,000	39	3,256	50	63,500
Barley .... do...	9,400	20	470	91	8,554
Buckwheat .... do...	....	....	....	....	....
Potatoes .... do...	750,000	102	7,353	67	502,500
Hay .... tons..	120,000	1.03	116,505	19 00	2,280,000
Total	....	....	137,233	....	3,100,934
CONNECTICUT.					
Indian corn .... bushels..	1,950,000	29	67,241	80	1,560,000
Wheat .... do...	36,500	17	2,147	1 45	52,925
Rye .... do...	420,000	14.3	29,370	91	382,200
Oats .... do...	1,220,000	30	40,667	59	719,800
Barley .... do...	27,500	23.5	1,170	87	23,925
Buckwheat .... do...	110,000	13	8,461	85	93,500
Potatoes .... do...	2,100,000	75	28,000	66	1,386,000
Hay .... tons..	580,000	1.10	527,272	18 75	10,875,000
Total	....	....	704,328	....	15,093,350

Table showing the product of each principal crop of the several States named, &c.—Continued.

Products.	Quantity produced in 1877.	Average yield per acre.	Number of acres in each crop.	Value per bushel or ton.	Total valuation.
NEW YORK.					
Indian corn .... bushels..	22, 700, 000	32	709, 375	$0 60	$13, 620, 000
Wheat .... do...	12, 800, 000	18	711, 111	1 22	15, 616, 000
Rye .... do...	3, 300, 000	15	220, 000	72	2, 376, 000
Oats .... do...	48, 000, 000	35	1, 371, 428	35	16, 800, 000
Barley .... do...	6, 200, 000	23	269, 565	70	4, 340, 000
Buckwheat .... do...	4, 200, 000	15. 5	270, 968	74	3, 108, 000
Potatoes .... do...	39, 300, 000	105	374, 286	42	16, 506, 000
Hay .... tons..	5, 250, 000	1. 20	4, 375, 000	9 60	50, 400, 000
Total	....	....	8, 301, 733	....	122, 766, 000
NEW JERSEY.					
Indian corn .... bushels..	9, 800, 000	36. 4	269, 231	52	5, 096, 000
Wheat .... do...	2, 200, 000	13. 8	159, 420	1 43	3, 146, 000
Rye .... do...	525, 000	14. 2	36, 972	70	367, 500
Oats .... do...	5, 250, 000	33. 5	156, 716	34	1, 785, 000
Barley .... do...	....	....	....	....	....
Buckwheat .... do...	300, 000	14. 5	20, 689	70	210, 000
Potatoes .... do...	5, 800, 000	108	53, 704	52	3, 016, 000
Hay .... tons..	610, 000	1. 30	469, 231	14 10	8, 601, 000
Total	....	....	1, 165, 963	....	22, 221, 500
PENNSYLVANIA.					
Indian corn .... bushels..	41, 120, 000	33	1, 246, 060	51	20, 971, 200
Wheat .... do...	18, 200, 000	13	1, 400, 000	1 36	24, 752, 000
Rye .... do...	3, 400, 000	14	242, 857	69	2, 346, 000
Oats .... do...	42, 400, 000	36	1, 177, 778	32	13, 568, 000
Barley .... do...	625, 000	24	26, 042	83	518, 750
Buckwheat .... do...	2, 800, 000	16	175, 000	68	1, 904, 000
Potatoes .... do...	13, 500, 000	90	150, 000	43	5, 805, 000
Hay .... tons..	3, 020, 000	1. 20	2, 516, 667	9 70	29, 294, 000
Total	....	....	6, 934, 404	....	99, 158, 950
DELAWARE.					
Indian corn .... bushels..	3, 950, 000	22	179, 545	50	1, 975, 000
Wheat .... do...	980, 000	13. 5	72, 592	1 40	1, 372, 000
Rye .... do...	12, 500	13	961	65	8, 125
Oats .... do...	415, 000	23	18, 043	35	145, 250
Barley .... do...	....	....	....	....	....
Buckwheat .... do...	....	....	....	....	....
Potatoes .... do...	405, 000	85	4, 765	50	202, 500
Hay .... tons..	40, 000	1. 10	36, 363	14 00	560, 000
Total	....	....	312, 269	....	4, 262, 875
MARYLAND.					
Indian corn .... bushels..	13, 360, 000	28	477, 143	53	7, 080, 800
Wheat .... do...	6, 780, 000	13. 8	491, 304	1 35	9, 153, 000
Rye .... do...	310, 000	12. 2	25, 410	60	186, 000
Oats .... do...	4, 550, 000	22	206, 818	32	1, 456, 000
Barley .... do...	....	....	....	....	....
Buckwheat .... do...	70, 000	15	4, 667	70	49, 000
Potatoes .... do...	1, 525, 000	90	16, 944	67	1, 021, 750
Hay .... tons..	240, 000	1. 25	192, 000	11 25	2, 700, 000
Total	....	....	1, 414, 286	....	21, 646, 550
VIRGINIA.					
Indian corn .... bushels..	19, 400, 000	19. 6	989, 796	46	8, 924, 000
Wheat .... do...	9, 450, 000	10. 4	908, 654	1 18	11, 151, 000
Rye .... do...	585, 000	10. 9	53, 670	49	286, 650
Oats .... do...	8, 000, 000	16	500, 000	34	2, 720, 000
Barley .... do...	....	....	....	....	....
Buckwheat .... do...	45, 000	13	3, 461	67	30, 150
Potatoes .... do...	1, 340, 000	75	17, 867	50	670, 000
Hay .... tons..	260, 000	1. 30	200, 000	11 00	2, 860, 000
Total	....	....	2, 673, 448	....	26, 641, 800

Table showing the product of each principal crop of the several States named, &c.—Continued.

Products.	Quantity produced in 1877.	Average yield per acre.	Number of acres in each crop.	Value per bushel.	Total valuation.
NORTH CAROLINA.					
Indian corn .... bushels..	22,800,000	14	1,628,571	$0 52	$11,856,000
Wheat .... do...	3,900,000	8.3	469,879	1 09	4,251,000
Rye .... do...	385,000	8.9	43,258	63	242,550
Oats .... do...	3,980,000	15.5	256,774	46	1,830,800
Barley .... do...	....	....	....	....	....
Buckwheat .... do...	....	....	....	....	....
Potatoes .... do...	853,000	72	11,847	78	665,340
Hay .... tons..	126,000	1.35	93,333	9 67	1,218,420
Total	....	....	2,503,662	....	20,064,110
SOUTH CAROLINA.					
Indian corn .... bushels..	11,200,000	9	1,244,444	78	8,736,000
Wheat .... do...	1,210,000	9.9	122,222	1 55	1,875,500
Rye .... do...	46,600	6.8	6,853	1 35	62,910
Oats .... do...	1,020,000	13	78,461	68	693,600
Barley .... do...	....	....	....	....	....
Buckwheat .... do...	....	....	....	....	....
Potatoes .... do...	105,000	85	1,235	62	65,100
Hay .... tons..	21,500	1.06	20,283	14 30	307,450
Total	....	....	1,473,498	....	11,740,560
GEORGIA.					
Indian corn .... bushels..	22,400,000	10.5	2,133,333	68	15,232,000
Wheat .... do...	3,800,000	9.5	400,000	1 36	5,168,000
Rye .... do...	....	....	....	....	....
Oats .... do...	5,300,000	13	407,692	65	3,445,000
Barley .... do...	....	....	....	....	....
Buckwheat .... do...	....	....	....	....	....
Potatoes .... do...	....	....	....	....	....
Hay .... tons..	21,800	1.25	17,440	16 00	348,800
Total	....	....	2,958,465	....	24,193,800
FLORIDA.					
Indian corn .... bushels..	3,050,000	12.9	236,434	71	2,165,500
Wheat .... do ..	....	....	....	....	....
Rye .... do...	....	....	....	....	....
Oats .... do...	140,000	14	10,000	95	133,000
Barley .... do...	....	....	....	....	....
Buckwheat .... do...	....	....	....	....	....
Potatoes .... do...	....	....	....	....	....
Hay .... tons..	....	....	....	....	....
Total	....	....	246,434	....	2,298,500
ALABAMA.					
Indian corn .... bushels..	23,000,000	12	1,916,667	68	15,640,000
Wheat .... do...	1,400,000	7	200,000	1 15	1,610,000
Rye .... do...	....	....	....	....	....
Oats .... do...	1,750,000	12	145,833	59	1,032,500
Barley .... do...	....	....	....	....	....
Buckwheat .... do...	....	....	....	....	....
Potatoes .... do...	300,000	70	4,286	86	258,000
Hay .... tons..	23,500	1.30	18,077	13 00	305,500
Total	....	....	2,284,863	....	18,846,000
MISSISSIPPI.					
Indian corn .... bushels..	20,800,000	15	1,386,667	62	12,896,000
Wheat .... do...	450,000	8	56,250	1 42	639,000
Rye .... do...	....	....	....	....	....
Oats .... do...	860,000	17.2	50,000	70	602,000
Barley .... do...	....	....	....	....	....
Buckwheat .... do...	....	....	....	....	....
Potatoes .... do...	325,000	84	3,869	81	263,250
Hay .... tons..	25,500	1.40	18,214	16 00	408,000
Total	....	....	1,515,000	....	14,808,250

Table showing the product of each principal crop of the several States named, &c.—Continued.

Products.	Quantity produced in 1877.	Average yield per acre.	Number of acres in each crop.	Value per bushel.	Total valuation.
LOUISIANA.					
Indian corn .... bushels..	12, 750, 000	17	750, 000	$0 58	$7, 395, 000
Wheat .... do..	....	....	....	....	....
Rye .... do..	....	....	....	....	....
Oats .... do..	....	....	....	....	....
Barley .... do..	....	....	....	....	....
Buckwheat .... do..	....	....	....	....	....
Potatoes .... do..	....	....	....	....	....
Hay .... tons..	....	....	....	....	....
Total	....	....	750, 000	....	7, 395, 000
TEXAS.					
Indian corn .... bushels..	49, 000, 000	24	2, 041, 667	43	21, 070, 000
Wheat .... do...	4, 800, 000	12	400, 000	1 21	5, 808, 000
Rye .... do...	....	....	....	....	....
Oats .... do...	4, 300, 000	33	130, 303	46	1, 978, 000
Barley .... do...	....	....	....	....	....
Buckwheat .... do...	....	....	....	....	....
Potatoes .... do...	550, 000	80	6, 875	1 00	550, 000
Hay .... tons..	75, 000	1. 25	60, 000	10 75	806, 250
Total	....	....	2, 638, 845	....	30, 212, 250
ARKANSAS.					
Indian corn .... bushels..	22, 100, 000	24	920, 833	44	9, 724, 000
Wheat .... do...	1, 610, 000	9	178, 889	88	1, 416, 800
Rye .... do...	58, 000	12	4, 833	75	43, 500
Oats .... do...	1, 600, 000	24	66, 667	42	672, 000
Barley .... do...	....	....	....	....	....
Buckwheat .... do...	....	....	....	....	....
Potatoes .... do...	650, 000	95	6, 842	65	422, 500
Hay .... tons..	20, 000	1. 40	14, 286	13 00	260, 000
Total	....	....	1, 192, 350	....	12, 538, 800
TENNESSEE.					
Indian corn .... bushels..	50, 500, 000	25	2, 020, 000	40	20, 200, 000
Wheat .... do...	11, 400, 000	8. 4	1, 357, 143	1 04	11, 856, 000
Rye .... do...	....	....	....	....	....
Oats .... do...	6, 100, 000	22	277, 273	40	2, 440, 000
Barley .... do...	....	....	....	....	....
Buckwheat .... do...	....	....	....	....	....
Potatoes .... do...	1, 350, 000	80	16, 875	52	702, 000
Hay .... tons..	152, 000	1. 30	116, 923	11 48	1, 744, 960
Total	....	....	3, 788, 214	....	36, 942, 960
WEST VIRGINIA.					
Indian corn .... bushels..	9, 600, 000	25. 5	376, 470	47	4, 512, 000
Wheat .... do...	3, 850, 000	12. 2	315, 574	1 24	4, 774, 000
Rye .... do...	315, 000	12	26, 250	70	220, 500
Oats .... do...	3, 300, 000	25	132, 000	31	1, 023, 000
Barley .... do...	53, 000	16	3, 312	70	37, 100
Buckwheat .... do...	75, 000	15. 2	4, 934	59	44, 250
Potatoes .... do...	1, 120, 000	85	13, 176	51	571, 200
Hay .... tons..	290, 000	1. 30	223, 077	8 50	2, 465, 000
Total	....	....	1, 094, 793	....	13, 647, 050
KENTUCKY.					
Indian corn .... bushels..	59, 500, 000	30. 3	1, 963, 696	32	19, 040, 000
Wheat .... do...	7, 150, 000	12. 5	572, 000	99	7, 078, 500
Rye .... do...	1, 125, 000	13	86, 538	54	607, 500
Oats .... do...	7, 850, 000	25	314, 000	34	2, 669, 000
Barley .... do...	270, 000	21	12, 857	66	178, 200
Buckwheat .... do...	....	....	....	....	....
Potatoes .... do...	2, 400, 000	87	27, 586	43	1, 032, 000
Hay .... tons..	320, 000	1. 30	246, 154	9 75	3, 120, 000
Total	....	....	3, 222, 831	....	33, 725, 200

Table showing the product of each principal crop of the several States named, &c.—Continued.

Products.	Quantity produced in 1877.	Average yield per acre.	Number of acres in each crop.	Value per bushel.	Total valuation.
OHIO.					
Indian corn........bushels..	97,000,000	31.5	3,079,365	$0 40	$38,800,000
Wheat........do...	26,000,000	15	1,733,333	1 24	32,240,000
Rye........do...	475,000	13.5	35,185	65	308,750
Oats........do...	28,500,000	32	890,625	28	7,980,000
Barley........do...	39,500	22	1,795	57	22,515
Buckwheat........do...	200,000	10.5	19,047	79	158,000
Potatoes........do...	11,300,000	90	125,555	40	4,520,000
Hay........tons..	2,100,000	1.25	1,680,000	8 04	16,884,000
Total........	....	....	7,564,905	....	100,913,265
MICHIGAN.					
Indian corn........bushels..	20,750,000	31	669,355	39	8,092,500
Wheat........do...	21,890,000	17.5	1,250,857	1 22	26,705,800
Rye........do...	280,000	16	17,500	64	179,200
Oats........do...	16,200,000	37	437,838	30	4,860,000
Barley........do...	975,000	25	39,000	60	585,000
Buckwheat........do...	670,000	16.5	40,606	58	388,600
Potatoes........do...	7,700,000	83	92,771	36	2,772,000
Hay........tons..	1,160,000	1.32	878,788	8 60	9,976,000
Total........	....	....	3,426,715	....	53,559,100
INDIANA.					
Indian corn........bushels..	96,000,000	30	3,200,000	34	32,640,000
Wheat........do...	24,600,000	14.5	1,696,552	1 13	27,798,000
Rye........do...	540,000	15	36,000	56	302,400
Oats........do...	13,750,000	25	550,000	24	3,300,000
Barley........do...	....	....	....	....	....
Buckwheat........do...	....	....	....	....	....
Potatoes........do...	5,800,000	84	69,047	38	2,204,000
Hay........tons..	1,050,000	1.24	846,774	6 50	6,825,000
Total........		....	6,398,373	....	73,069,400
ILLINOIS.					
Indian corn........bushels..	260,000,000	29	8,965,517	29	75,400,000
Wheat........do...	33,000,000	16.5	2,000,000	1 04	34,320,000
Rye........do...	2,844,000	18	158,000	50	1,422,000
Oats........do...	59,200,000	37	1,600,000	22	13,024,000
Barley........do...	2,760,000	23	120,000	78	2,152,800
Buckwheat........do...	176,000	16	11,000	73	128,480
Potatoes........do...	12,834,000	93	138,000	44	5,646,960
Hay........tons..	3,936,000	1.60	2,460,000	5 87	23,104,320
Total........	....	....	15,452,517	....	155,198,560
WISCONSIN.					
Indian corn........bushels..	28,700,000	28	1,025,000	33	9,471,000
Wheat........do...	22,000,000	15	1,466,667	93	20,460,000
Rye........do...	2,700,000	15.5	174,193	52	1,404,000
Oats........do...	30,750,000	36	854,167	23	7,072,500
Barley........do...	4,700,000	25.8	182,170	50	2,350,000
Buckwheat........do...	420,000	12.5	33,600	50	210,000
Potatoes........do...	11,500,000	90	127,778	35	4,025,000
Hay........tons..	1,350,000	1.30	1,038,461	7 00	9,450,000
Total........	....	....	4,902,036	....	54,442,500
MINNESOTA.					
Indian corn........bushels..	13,200,000	29	455,172	38	5,016,000
Wheat........do...	33,324,346	18.5	1,801,316	91	30,325,154
Rye........do...	162,000	15.7	10,318	53	85,860
Oats........do...	14,740,000	33.5	440,000	31	4,569,400
Barley........do...	1,832,000	25.5	71,843	45	824,400
Buckwheat........do...	103,000	13	7,923	60	61,800
Potatoes........do...	2,300,000	66	34,848	44	1,012,000
Hay........tons..	1,070,000	1.20	891,667	5 25	5,617,500
Total........	....	....	3,713,087	....	47,512,114
IOWA.					
Indian corn........bushels..	156,000,000	32.5	4,800,000	25	39,000,000
Wheat........do...	37,810,000	14.5	2,607,584	87	32,894,700
Rye........do...	....	....	....	....	....
Oats........do...	42,000,000	38	1,105,263	20	8,400,000
Barley........do...	5,300,000	23	230,435	40	2,120,000
Buckwheat........do...	....	....	....	....	....

Table showing the product of each principal crop of the several States named, &c.—Continued.

Products.	Quantity produced in 1877.	Average yield per acre.	Number of acres in each crop.	Value per bushel.	Total valuation.
IOWA—Continued.					
Potatoes .... bushels..	9, 500, 000	100.	95, 000	$0 38	$3, 610, 000
Hay .... tons..	2, 550, 000	1. 30	1, 961, 538	4 75	12, 112, 500
Total	....	....	10, 799, 820	....	98, 137, 200
MISSOURI.					
Indian corn .... bushels..	103, 000, 000	29	3, 551, 724	27	27, 810, 000
Wheat .... do...	20, 000, 000	14	1, 428, 571	1 00	20, 000, 000
Rye .... do...	720, 000	15. 5	46, 451	53	381, 600
Oats .... do...	20, 500, 000	33	621, 212	21	4, 305, 000
Barley .... do...	....	....	....	....	....
Buckwheat .... do...	....	....	....	....	....
Potatoes .... do...	6, 250, 000	90	69, 444	44	2, 750, 000
Hay .... tons..	1, 050, 000	1. 40	750, 000	7 00	7, 350, 000
Total	....	....	6, 467, 402	....	62, 596, 600
KANSAS.					
Indian corn .... bushels..	98, 900, 000	36. 5	2, 709, 589	21	20, 769, 000
Wheat .... do...	14, 400, 000	13. 5	1, 066, 667	82	11, 808, 000
Rye .... do...	2, 410, 000	20	120, 500	36	867, 600
Oats .... do...	12, 200, 000	38	321, 052	18	2, 196, 000
Barley .... do...	1, 900, 000	23. 5	80, 851	33	627, 000
Buckwheat .... do...	58, 000	14	4, 143	75	43, 500
Potatoes .... do...	3, 200, 000	72	44, 444	62	1, 984, 000
Hay .... tons..	1, 155, 000	1. 65	700, 000	3 50	4, 042, 500
Total	....	....	5, 047, 246	....	42, 337, 600
NEBRASKA.					
Indian corn .... bushels..	38, 500, 000	38	1, 013, 158	18	6, 930, 000
Wheat .... do...	5, 640, 000	15	376, 000	83	4, 681, 200
Rye .... do...	....	....	....	....	....
Oats .... do...	5, 400, 000	40	135, 000	15	810, 000
Barley .... do...	520, 000	24	21, 667	27	140, 400
Buckwheat .... do...	....	....	....	....	....
Potatoes .... do...	1, 500, 000	105	14, 286	40	600, 000
Hay .... tons..	475, 000	1. 45	327, 586	3 65	1, 733, 750
Total	....	....	1, 887, 697	....	14, 895, 350
CALIFORNIA.					
Indian corn .... bushels..	1, 550, 000	30	51, 667	95	1, 472, 500
Wheat .... do...	22, 000, 000	9. 5	2, 315, 789	1 30	28, 600, 000
Rye .... do...	....	....	....	....	....
Oats .... do...	1, 750, 000	25	70, 000	73	1, 277, 500
Barley .... do...	7, 800, 000	16	487, 500	90	7, 020, 000
Buckwheat .... do...	....	....	....	....	....
Potatoes .... do...	3, 200, 000	100	32, 000	75	2, 400, 000
Hay .... tons..	560, 000	. 90	622, 222	15 00	8, 400, 000
Total	....	....	3, 579, 178	....	49, 170, 000
OREGON.					
Indian corn .... bushels..	128, 000	26	4, 923	90	115, 200
Wheat .... do...	6, 875, 000	20	343, 750	1 11	7, 631, 250
Rye .... do...	19, 000	22	863	97	18, 430
Oats .... do...	3, 600, 000	35	102, 857	46	1, 656, 000
Barley .... do...	480, 000	29	16, 552	71	340, 800
Buckwheat .... do...	....	....	....	....	....
Potatoes .... do...	860, 000	140	6, 143	64	550, 400
Hay .... tons..	160, 000	1. 50	106, 667	11 00	1, 7[illegible]0, 00
Total	....	....	581, 755	....	12, 072, 800
NEVADA, COLORADO, AND THE TERRITORIES.					
Indian corn .... bushels..	2, 100, 000	25	84, 000	70	1, 470, 000
Wheat .... do...	5, 500, 000	18	305, 555	1 05	5, 775, 000
Rye .... do...	....	....	....	....	....
Oats .... do...	2, 250, 000	31	72, 580	60	1, 350, 000
Barley .... do...	....	....	....	....	....
Buckwheat .... do...	....	....	....	....	....
Potatoes .... do...	1, 100, 000	105	10, 476	65	715, 000
Hay .... tons..	250, 000	1. 30	192, 308	11 00	2, 750, 000
Total	....	....	664, 919	....	12, 060, 000

Summary for each State, showing the product, the area, and the value of each crop for 1877.

States.	CORN.			WHEAT.			RYE.		
	Bushels.	Acres.	Value.	Bushels.	Acres.	Value.	Bushels.	Acres.	Value.
Maine	1,680,000	46,667	$1,310,400	350,000	25,000	$560,000	37,000	2,643	$37,000
New Hampshire	2,400,000	56,470	1,896,000	220,000	12,941	352,000	49,000	3,267	45,080
Vermont	2,150,000	55,128	1,655,500	550,000	28,947	797,500	82,000	4,686	70,520
Massachusetts	1,250,000	36,023	875,000	18,300	832	27,450	348,000	24,857	271,440
Rhode Island	270,000	8,182	226,800	....	....	....	22,000	1,467	19,580
Connecticut	1,950,000	67,241	1,560,000	36,500	2,147	52,925	420,000	29,370	382,200
New York	22,700,000	709,375	13,620,000	12,800,000	711,111	15,616,000	3,300,000	220,000	2,376,000
New Jersey	9,800,000	269,231	5,096,000	2,200,000	159,420	3,146,000	525,000	36,972	367,500
Pennsylvania	41,120,000	1,246,060	20,971,200	18,200,000	1,400,000	24,752,000	3,400,000	242,857	2,346,000
Delaware	3,950,000	179,545	1,975,000	980,000	72,592	1,372,000	12,500	961	8,125
Maryland	13,360,000	477,143	7,080,800	6,780,000	491,304	9,153,000	310,000	25,410	186,000
Virginia	19,400,000	989,796	8,924,000	9,450,000	908,654	11,151,000	585,000	53,670	286,650
North Carolina	22,800,000	1,628,571	11,856,000	3,900,000	469,879	4,251,000	385,000	43,258	242,550
South Carolina	11,200,000	1,244,444	8,736,000	1,210,000	122,222	1,875,500	46,600	6,853	62,910
Georgia	22,400,000	2,133,333	15,232,000	3,800,000	400,000	5,168,000	....	....	....
Florida	3,050,000	236,434	2,165,500	....	....	....	....	....	....
Alabama	23,000,000	1,916,667	15,640,000	1,400,000	200,000	1,610,000	....	....	....
Mississippi	20,800,000	1,386,667	12,896,000	450,000	56,250	639,000	....	....	....
Louisiana	12,750,000	750,000	7,395,000	....	....	....	....	....	....
Texas	49,000,000	2,041,667	21,070,000	4,800,000	400,000	5,808,000	....	....	....
Arkansas	22,100,000	920,833	9,724,000	1,610,000	178,889	1,416,800	58,000	4,833	43,500
Tennessee	50,500,000	2,020,000	20,200,000	11,400,000	1,357,143	11,856,000	....	....	....
West Virginia	9,600,000	376,470	4,512,000	3,850,000	315,574	4,774,000	315,000	26,250	220,500
Kentucky	59,500,000	1,963,696	19,040,000	7,150,000	572,000	7,078,500	1,125,000	86,538	607,500
Ohio	97,000,000	3,079,365	38,800,000	26,000,000	1,733,333	32,240,000	475,000	35,185	308,750
Michigan	20,750,000	669,355	8,092,500	21,890,000	1,250,857	26,705,800	280,000	17,500	179,200
Indiana	96,000,000	3,200,000	32,640,000	24,600,000	1,696,552	27,798,000	540,000	36,000	302,400
Illinois	260,000,000	8,965,517	75,400,000	33,000,000	2,000,000	34,320,000	2,844,000	158,000	1,422,000
Wisconsin	28,700,000	1,025,000	9,471,000	22,000,000	1,466,667	20,460,000	2,700,000	174,193	1,404,000
Minnesota	13,200,000	455,172	5,016,000	33,324,346	1,801,316	30,325,154	162,000	10,318	85,860
Iowa	156,000,000	4,800,000	39,000,000	37,810,000	2,607,584	32,894,700	....	....	....
Missouri	103,000,000	3,551,724	27,810,000	20,000,000	1,428,571	20,000,000	720,000	46,451	381,600
Kansas	98,900,000	2,709,589	20,769,000	14,400,000	1,066,667	11,808,000	2,410,000	120,500	867,600
Nebraska	38,500,000	1,013,158	6,930,000	5,640,000	376,000	4,681,200	....	....	....
California	1,550,000	51,667	1,472,500	22,000,000	2,315,789	28,600,000	....	....	....
Oregon	128,000	4,923	115,200	6,875,000	343,750	7,631,250	19,000	863	18,430
Nevada, Colorado, and the Territories	2,100,000	84,000	1,470,000	5,500,000	305,555	5,775,000	....	....	....
Total	1,342,558,000	50,369,113	480,643,400	364,194,146	26,277,546	394,675,779	21,170,100	1,412,902	12,542,895

Summary for each State, showing the product, the area, and the value of each crop for 1877—Continued.

States.	OATS.			BARLEY.			BUCKWHEAT.		
	Bushels.	Acres.	Value.	Bushels.	Acres.	Value.	Bushels.	Acres.	Value.
Maine	2,412,000	104,869	$1,085,400	650,000	37,143	$494,000	400,000	18,182	$236,000
New Hampshire	1,550,000	36,046	666,500	110,000	4,782	82,500	96,000	5,333	52,800
Vermont	4,850,000	124,359	2,037,000	130,000	5,000	110,500	405,000	18,409	243,000
Massachusetts	580,000	16,571	295,800	60,000	2,500	52,200	49,000	3,500	37,730
Rhode Island	127,000	3,256	63,500	9,400	470	8,554			
Connecticut	1,220,000	40,667	719,800	27,500	1,170	23,925	110,000	8,461	93,500
New York	48,000,000	1,371,428	16,800,000	6,200,000	269,565	4,340,000	4,200,000	270,968	3,108,000
New Jersey	5,250,000	156,716	1,785,000				300,000	20,689	210,000
Pennsylvania	42,400,000	1,177,778	13,568,000	625,000	26,042	518,750	2,800,000	175,000	1,904,000
Delaware	415,000	18,043	145,250						
Maryland	4,550,000	206,818	1,456,000				70,000	4,667	49,000
Virginia	8,000,000	500,000	2,720,000				45,000	3,461	30,150
North Carolina	3,980,000	256,774	1,830,800						
South Carolina	1,020,000	78,461	693,600						
Georgia	5,300,000	407,692	3,445,000						
Florida	140,000	10,000	133,000						
Alabama	1,750,000	145,833	1,032,500						
Mississippi	860,000	50,000	602,000						
Louisiana									
Texas	4,300,000	130,303	1,978,000						
Arkansas	1,600,000	66,667	672,000						
Tennessee	6,100,000	277,273	2,440,000						
West Virginia	3,300,000	132,000	1,023,000	53,000	3,312	37,100	75,000	4,934	44,250
Kentucky	7,850,000	314,000	2,669,000	270,000	12,857	178,200			
Ohio	28,500,000	890,625	7,980,000	39,500	1,795	22,515	200,000	19,047	158,000
Michigan	16,200,000	437,838	4,860,000	975,000	39,000	585,000	670,000	40,606	388,600
Indiana	13,750,000	550,000	3,300,000						
Illinois	59,200,000	1,600,000	13,024,000	2,760,000	120,000	2,152,800	176,000	11,000	128,480
Wisconsin	30,750,000	854,167	7,072,500	4,700,000	182,170	2,350,000	420,000	33,600	210,000
Minnesota	14,740,000	440,000	4,569,400	1,632,000	71,843	824,400	103,000	7,923	61,800
Iowa	42,000,000	1,105,263	8,400,000	5,300,000	230,435	2,120,000			
Missouri	20,500,000	621,212	4,305,000						
Kansas	12,200,000	321,052	2,196,000	1,900,000	80,851	627,000	58,000	4,143	43,500
Nebraska	5,400,000	135,000	810,000	520,000	21,667	140,400			
California	1,750,000	70,000	1,277,500	7,800,000	487,500	7,020,000			
Oregon	3,600,000	102,857	1,656,000	480,000	16,552	340,800			
Nevada, Colorado, and the Territories	2,250,000	72,580	1,350,000						
Total	406,394,000	12,826,148	118,661,550	34,441,400	1,614,654	22,028,644	10,177,000	649,923	6,998,810

Summary for each State, showing the product, the area, and the value of each crop for 1877—Continued.

States.	POTATOES.			HAY.		
	Bushels.	Acres.	Value.	Tons.	Acres.	Value.
Maine	7,000,000	70,000	$3,220,000	1,138,000	1,264,444	$14,225,000
New Hampshire	4,480,000	40,000	2,240,000	715,000	650,000	8,437,000
Vermont	5,780,000	44,461	2,312,000	1,050,000	1,071,428	10,605,000
Massachusetts	3,415,000	32,524	2,049,000	665,000	665,000	10,108,000
Rhode Island	750,000	7,353	502,500	120,000	116,505	2,280,000
Connecticut	2,100,000	28,000	1,386,000	580,000	527,272	10,875,000
New York	39,300,000	374,286	16,506,000	5,250,000	4,375,000	50,400,000
New Jersey	5,800,000	53,704	3,016,000	610,000	469,231	8,601,000
Pennsylvania	13,500,000	150,000	5,805,000	3,020,000	2,516,667	29,294,000
Delaware	405,000	4,765	202,500	40,000	36,363	560,000
Maryland	1,525,000	16,944	1,021,750	240,000	192,000	2,700,000
Virginia	1,340,000	17,867	670,000	260,000	200,000	2,860,000
North Carolina	853,000	11,847	665,340	126,000	93,333	1,218,420
South Carolina	105,000	1,235	65,100	21,500	20,283	307,450
Georgia				21,800	17,440	348,800
Florida						
Alabama	300,000	4,286	258,000	23,500	18,077	305,500
Mississippi	325,000	3,869	263,250	25,500	18,214	408,000
Louisiana						
Texas	550,000	6,875	550,000	75,000	60,000	806,250
Arkansas	650,000	6,842	422,500	20,000	14,286	260,000
Tennessee	1,350,000	16,875	702,000	152,000	116,923	1,744,960
West Virginia	1,120,000	13,176	571,200	290,000	223,077	2,465,000
Kentucky	2,400,000	27,586	1,032,000	320,000	246,154	3,120,000
Ohio	11,300,000	125,555	4,520,000	2,100,000	1,680,000	16,884,000
Michigan	7,700,000	92,771	2,772,000	1,160,000	878,788	9,976,000
Indiana	5,800,000	69,047	2,204,000	1,050,000	846,774	6,825,000
Illinois	12,834,000	138,000	5,646,960	3,936,000	2,460,000	23,104,320
Wisconsin	11,500,000	127,778	4,025,000	1,350,000	1,038,461	9,450,000
Minnesota	2,300,000	34,848	1,012,000	1,070,000	891,667	5,617,500
Iowa	9,500,000	95,000	3,610,000	2,550,000	1,961,538	12,112,500
Missouri	6,250,000	69,444	2,750,000	1,050,000	750,000	7,350,000
Kansas	3,200,000	44,444	1,984,000	1,155,000	700,000	4,042,500
Nebraska	1,500,000	14,286	600,000	475,000	327,586	1,733,750
California	3,200,000	32,000	2,400,000	560,000	622,222	8,400,000
Oregon	860,000	6,143	550,400	160,000	106,667	1,760,000
Nevada, Colorado, and the Territories	1,100,000	10,476	715,000	250,000	192,308	2,750,000
Total	170,092,000	1,792,287	76,249,500	31,629,300	25,367,708	271,934,950

Table showing the average yield per acre and the price per bushel or ton of farm products for the year 1877.

States.	CORN.		WHEAT.		RYE.		OATS.		BARLEY.		BUCKWHEAT.		POTATOES.		HAY.	
	Bushels.	Price per bushel.	Bushels.	Price per bushel.	Bushels.	Price per bushel.	Bushels.	Price per bushel.	Bushels.	Price per bushel.	Bushels.	Price per bushel.	Bushels.	Price per bushel.	Tons.	Price per ton.
Maine	36	$0 78	14	$1 60	14	$1 00	23	$0 45	17.5	$0 76	22	$0 59	100	$1 46	0.90	$12 50
New Hampshire	42.5	79	17	1 60	15	92	43	43	23	75	18	55	112	50	1.10	11 80
Vermont	39	77	19	1 45	17.5	86	39	42	26	85	22	60	130	40	.98	10 10
Massachusetts	34.7	70	22	1 50	14	78	35	51	24	87	14	77	105	60	1.00	15 20
Rhode Island	33	84	....	....	15	89	39	50	20	91	....	....	102	67	1.03	19 00
Connecticut	29	80	17	1 45	14.3	91	30	59	23.5	87	13	85	75	66	1.10	18 75
New York	32	60	18	1 22	15	72	35	35	23	70	15.5	74	105	42	1.20	9 60
New Jersey	36.4	52	13.8	1 43	14.2	70	33.5	34	....	....	14.5	70	108	52	1.30	14 10
Pennsylvania	33	51	13	1 36	14	69	36	32	24	83	16	68	90	43	1.20	9 70
Delaware	22	50	13.5	1 40	13	65	23	35	....	....	....	....	85	50	1.10	14 00
Maryland	28	53	13.8	1 35	12.2	60	22	32	....	....	15	70	90	67	1.25	11 25
Virginia	19.6	46	10.4	1 18	10.9	49	16	34	....	....	13	67	75	50	1.30	11 00
North Carolina	14	52	8.3	1 09	8.9	63	15.5	46	....	....	....	....	72	78	1.35	9 67
South Carolina	9	78	9.9	1 55	6.8	1 35	13	68	....	....	....	....	85	62	1.06	14 30
Georgia	10.5	68	9.5	1 36	....	....	13	65	....	....	....	....	....	....	1.25	16 00
Florida	12.9	71	....	....	....	....	14	95	....	....	....	....	....	....	....	....
Alabama	12	68	7	1 15	....	....	12	59	....	....	....	....	70	86	1.30	13 00
Mississippi	15	62	8	1 42	....	....	17.2	70	....	....	....	....	84	81	1.40	16 00
Louisiana	17	58	....	....	....	....	....	....	....	....	....	....	....	....	....	....
Texas	24	43	12	1 21	....	....	33	46	....	....	....	....	80	1 00	1.25	10 75
Arkansas	24	44	9	88	12	75	24	42	....	....	....	....	95	65	1.40	13 00
Tennessee	25	40	8.4	1 04	....	....	22	40	....	....	....	....	80	52	1.30	11 48
West Virginia	25.5	47	12.2	1 24	12	70	25	31	16	70	15.2	59	85	51	1.30	8 50
Kentucky	30.3	32	12.5	99	13	54	25	34	21	66	....	....	87	43	1.30	9 75
Ohio	31.5	40	15	1 24	13.5	65	32	28	22	57	10.5	79	90	40	1.25	8 04
Michigan	31	39	17.5	1 22	16	64	37	30	25	60	16.5	58	83	36	1.32	8 60
Indiana	30	34	14.5	1 13	15	56	25	24	....	....	....	....	84	38	1.24	6 50
Illinois	29	29	16.5	1 04	18	50	37	22	23	78	16	73	93	44	1.60	5 87
Wisconsin	28	33	15	93	15.5	52	36	23	25.8	50	12.5	50	90	35	1.30	7 00
Minnesota	29	38	18.5	91	15.7	53	33.5	31	25.5	45	13	60	66	44	1.20	5 25
Iowa	32.5	25	14.5	87	....	....	38	20	23	40	....	....	100	38	1.30	4 75
Missouri	29	27	14	1 00	15.5	53	33	21	....	....	....	....	90	44	1.40	7 00
Kansas	36.5	21	13.5	82	20	36	38	18	23.5	33	14	75	72	62	1.65	3 50
Nebraska	38	18	15	83	....	....	40	15	24	27	....	....	105	40	1.45	3 65
California	30	95	9.5	1 30	....	....	25	73	16	90	....	....	100	75	90	15 00
Oregon	26	90	20	1 11	22	97	35	46	29	71	....	....	140	64	1.50	11 00
Nevada, Colorado, and the Territories	25	70	18	1 05	....	....	31	60	....	....	....	....	105	65	1.30	11 00

Table showing the average cash value per acre of the principal crops of the farm, taken together, for the year 1877.

States.	Average value per acre.	States.	Average value per acre.
Maine	$13 49	Texas	$11 45
New Hampshire	17 02	Arkansas	10 51
Vermont	13 18	Tennessee	9 75
Massachusetts	17 54	West Virginia	12 46
Rhode Island	22 59	Kentucky	10 46
Connecticut	21 43	Ohio	13 34
New York	14 79	Michigan	15 63
New Jersey	19 06	Indiana	11 42
Pennsylvania	14 30	Illinois	10 04
Delaware	13 65	Wisconsin	11 10
Maryland	15 30	Minnesota	12 79
Virginia	9 96	Iowa	9 09
North Carolina	8 01	Missouri	9 68
South Carolina	7 97	Kansas	8 39
Georgia	8 18	Nebraska	7 89
Florida	9 32	California	13 73
Alabama	8 25	Oregon	20 75
Mississippi	9 77	Nevada, Colorado, and the Territories	18 13
Louisiana	9 86		

Table showing the average cash value per acre of farm products for the year 1877.

States.	Corn.	Wheat.	Rye.	Oats.	Barley.	Buckwheat.	Potatoes.	Hay.
Maine	$28 08	$22 40	$14 00	$10 35	$13 30	$12 98	$46 00	$11 25
New Hampshire	33 57	27 20	13 80	18 49	17 25	9 90	56 00	12 98
Vermont	30 03	27 55	15 05	16 38	22 10	13 20	52 00	9 89
Massachusetts	24 29	33 00	10 92	17 85	20 88	10 78	63 00	15 20
Rhode Island	27 72	....	13 35	19 50	18 20	....	68 34	19 57
Connecticut	23 20	24 65	13 01	17 70	20 44	11 05	49 50	20 62
New York	19 20	21 96	10 80	12 25	16 10	11 47	44 10	11 52
New Jersey	18 92	19 73	9 94	11 39	....	10 15	56 16	18 35
Pennsylvania	16 83	17 68	9 66	11 52	19 92	10 88	38 70	11 64
Delaware	11 00	18 90	8 45	8 05	....	....	42 50	15 40
Maryland	14 84	18 63	7 32	7 04	....	10 50	60 30	14 06
Virginia	9 01	12 27	5 34	5 44	....	8 71	37 50	14 30
North Carolina	7 28	9 04	5 60	7 13	....	....	56 16	13 05
South Carolina	7 02	15 34	9 18	8 84	....	....	52 70	15 15
Georgia	7 14	12 92	....	8 45	....	....	....	20 00
Florida	9 15	....	....	13 30	....	....	....	....
Alabama	8 16	8 05	....	7 08	....	....	60 20	16 90
Mississippi	9 30	11 36	....	12 04	....	....	68 04	22 40
Louisiana	9 86	....	....	....	....	....	....	....
Texas	10 32	14 52	....	15 18	....	....	80 00	13 43
Arkansas	10 56	7 92	9 00	10 08	....	....	61 75	18 20
Tennessee	10 00	8 73	....	8 80	....	....	41 60	14 92
West Virginia	11 98	15 12	8 40	7 75	11 20	8 96	43 35	11 05
Kentucky	9 69	12 37	7 02	8 50	13 86	....	37 41	12 67
Ohio	12 60	18 60	8 77	8 96	12 54	8 29	36 00	10 05
Michigan	12 09	21 35	10 24	11 10	15 00	9 57	29 88	11 35
Indiana	10 20	16 38	8 40	6 00	....	....	31 92	8 06
Illinois	8 41	17 16	9 00	8 14	17 94	11 68	40 92	9 39
Wisconsin	9 24	13 95	8 06	8 28	12 90	6 25	31 50	9 10
Minnesota	11 02	16 83	8 32	10 38	11 47	7 80	29 04	6 30
Iowa	8 12	12 61	....	7 60	9 20	....	38 00	6 17
Missouri	7 83	14 00	8 21	6 93	....	....	39 60	9 80
Kansas	7 66	11 07	7 20	6 84	7 75	10 50	44 64	5 77
Nebraska	6 84	12 45	....	6 00	6 48	....	42 00	5 29
California	28 50	12 35	....	18 25	14 40	....	75 00	13 50
Oregon	23 40	22 20	21 34	16 10	20 59	....	89 60	16 50
Nevada, Colorado, and the Territories	17 50	18 90	....	18 60	....	....	68 25	14 30

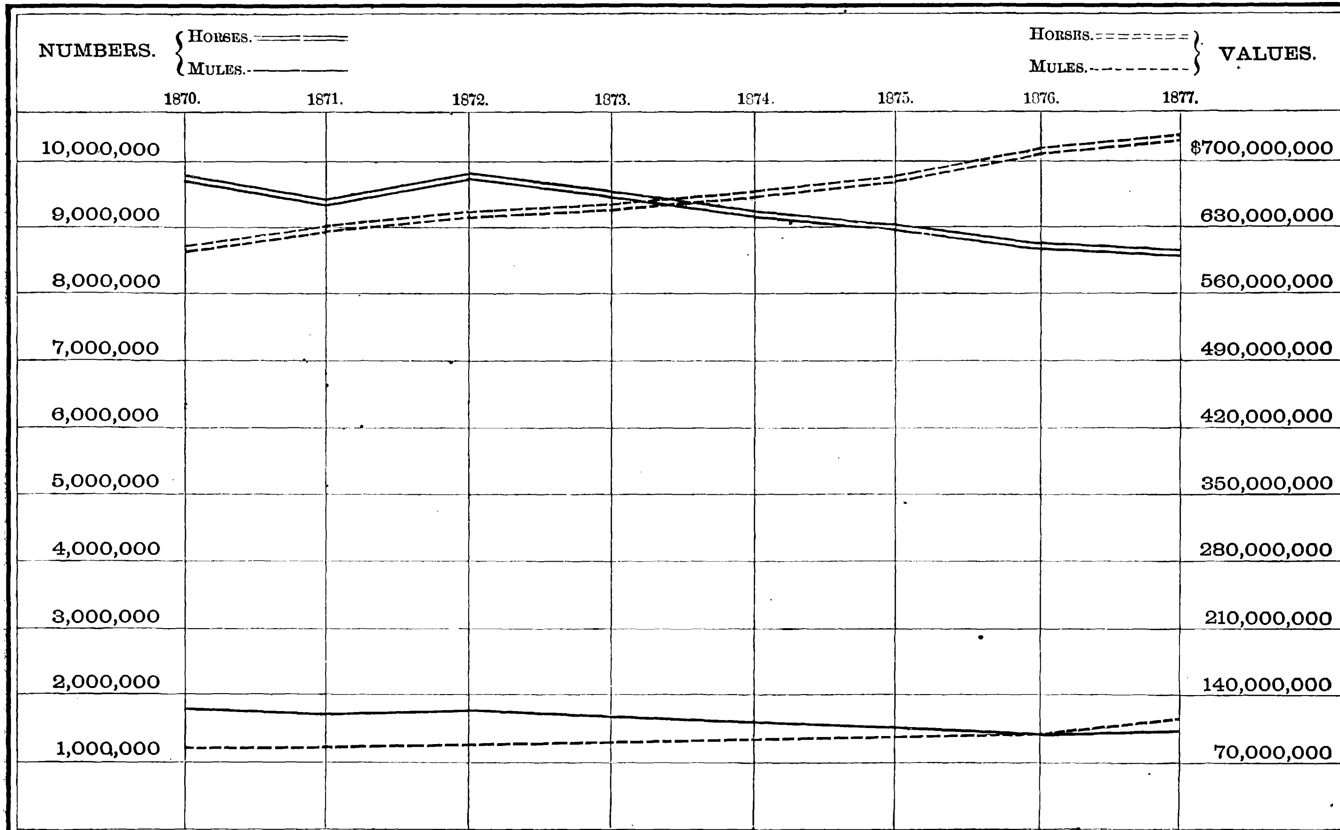
A general summary showing the estimated quantities, number of acres, and aggregate value of the principal crops of the farm in 1877.

Products.	Number of bushels, &c.	Number of acres.	Value.
Indian corn ....bushels..	1, 342, 558, 000	50, 369, 113	$480, 643, 400
Wheat ....do....	364, 194, 146	26, 277, 546	394, 695, 779
Rye ....do....	21, 170, 100	1, 412, 902	12, 542, 895
Oats..do....	406, 394, 000	12, 826, 148	118, 661, 550
Barley...do....	34, 441, 400	1, 614, 654	22, 028, 644
Buckwheat...do....	10, 177, 000	649, 923	6, 998, 810
Potatoes ....do....	170, 092, 000	1, 792, 287	76, 249, 500
Total..	2, 349, 026, 646	94, 942, 573	1, 111, 820, 578
Hay ....tons..	31, 629, 300	25, 367, 708	271, 934, 950
Cotton ....bales..	4, 750, 000	12, 600, 000	....

Table showing the average yield and cash value per acre, and price per bushel or ton, of farm products for the year 1877.

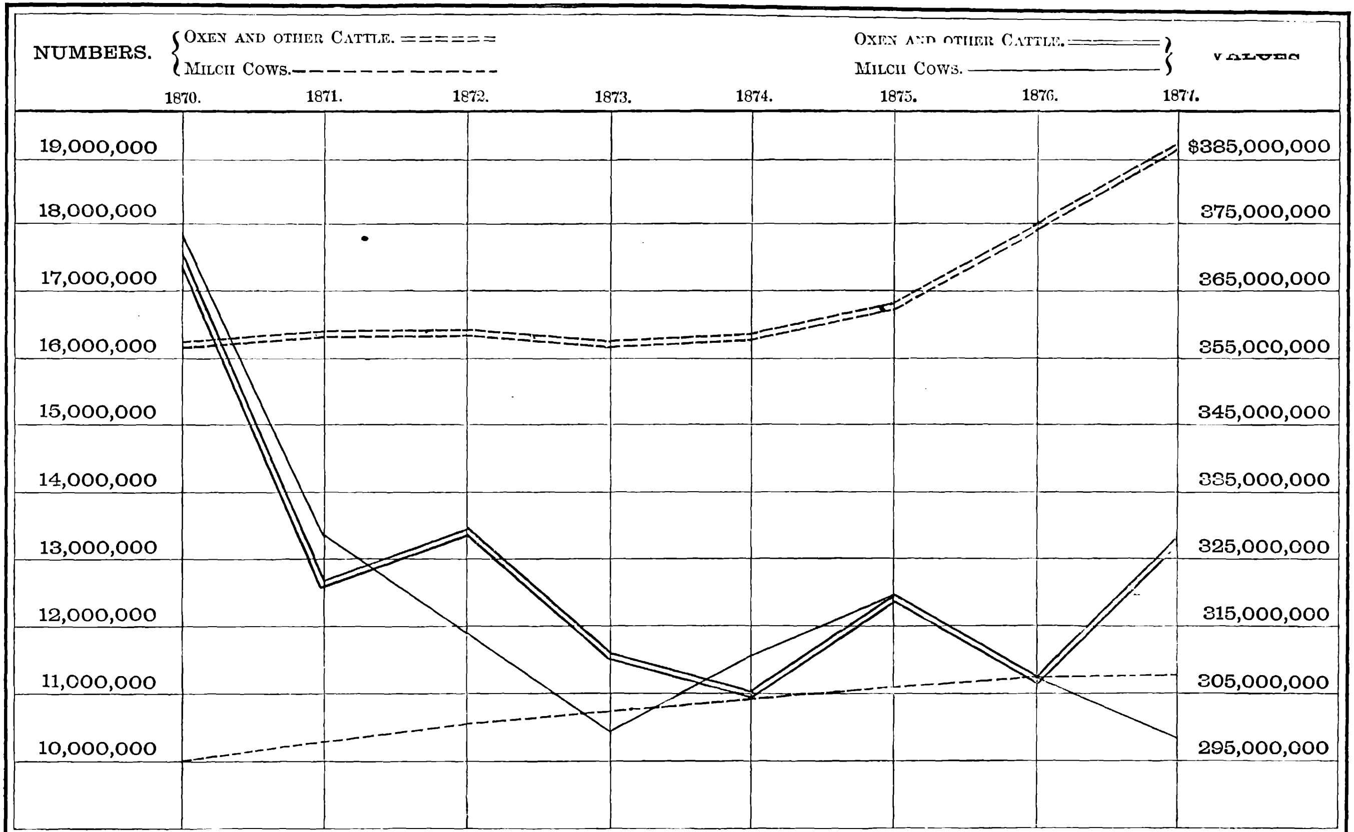
Products.	Average yield per acre.	Average price per bushel.	Average value per acre.	Products.	Average yield per acre.	Average price per bushel or ton.	Average value per acre.
Indian corn......bush.	26. 6+	$0 35. 8+	$9 54	Buckwheat......bush.	15. 6+	$0 68. 7+	$10 76
Wheat ....do..	13. 9+	1 08. 2+	15 08	Potatoes ....do..	94. 9	44. 8+	42 54
Rye ....do..	14. 9+	59. 2+	8 87	Hay...............tons.	1. 24	8 59. 7+	10 72
Oats................do..	31. 6	29. 2−	9 25				
Barley ....do..	21. 3	63. 9+	13 64				

DIAGRAM V.



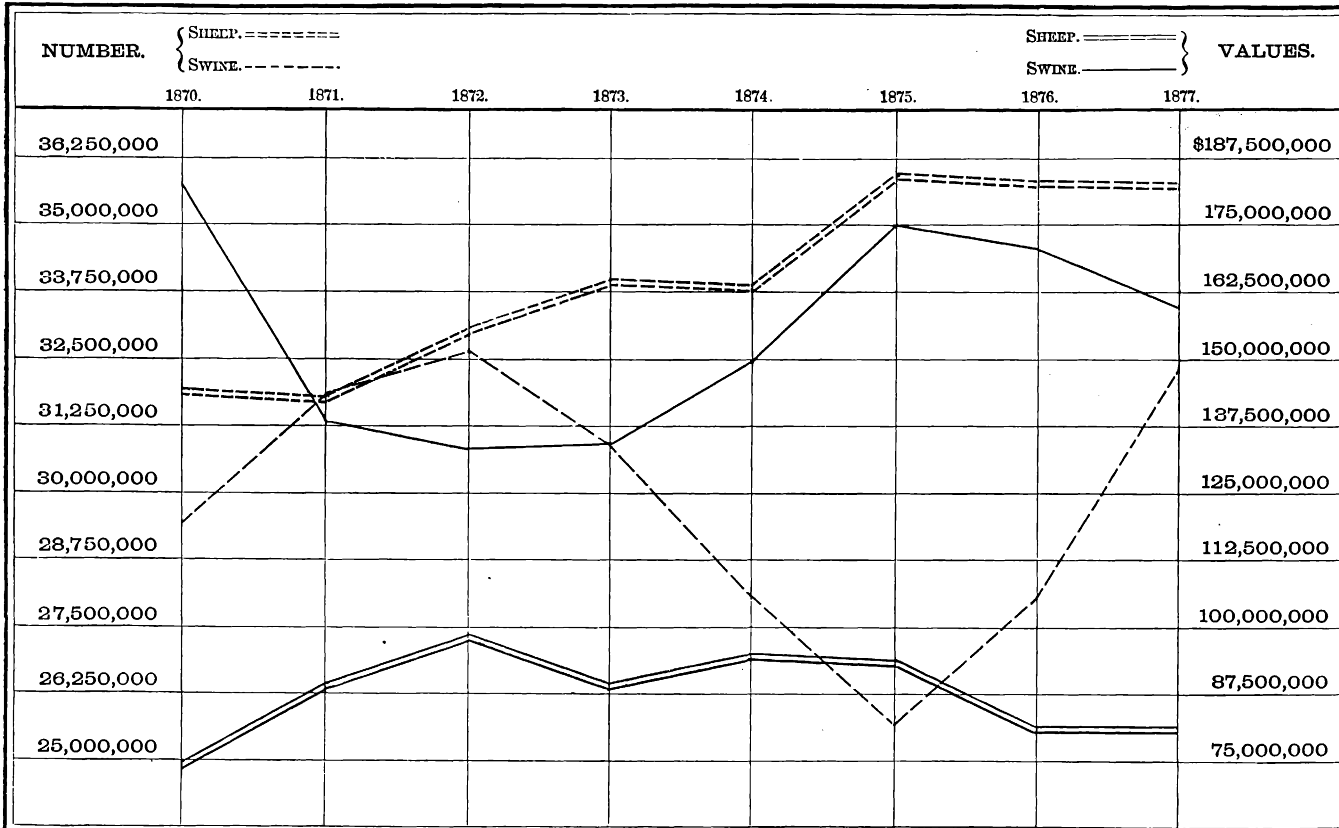
Numbers and Prices of Horses and Mules.

DIAGRAM VI.



Numbers and Prices of Cattle.

DIAGRAM VII.



Numbers and Prices of Sheep and Swine.

M. JOYCE, WASHINGTON.

Table showing the estimated total number and total value of each kind of live stock, and the average price, in January, 1878.

States.	OXEN AND OTHER CATTLE.			SHEEP.			HOGS.		
	Number.	Average price.	Value.	Number.	Average price.	Value.	Number.	Average price.	Value.
Maine	195, 800	$24 19	$4, 736, 402	525, 800	$2 78	$1, 461, 724	62, 200	$7 74	$481, 428
New Hampshire	121, 400	29 87	3, 626, 218	239, 900	2 60	623, 740	42, 900	12 72	545, 688
Vermont	130, 400	22 96	2, 993, 984	461, 400	2 82	1, 301, 148	54, 300	8 00	434, 400
Massachusetts	112, 600	37 25	4, 194, 350	60, 300	3 60	217, 080	78, 600	13 86	1, 089, 396
Rhode Island	15, 900	44 90	713, 910	24, 500	3 75	91, 875	18, 100	13 55	245, 255
Connecticut	112, 900	35 84	4, 046, 336	92, 500	3 70	342, 250	59, 500	11 60	690, 200
New York	696, 300	28 30	19, 705, 290	1, 518, 100	3 30	5, 009, 730	975, 000	8 36	8, 151, 000
New Jersey	83, 700	36 72	3, 073, 464	128, 300	4 46	572, 218	154, 400	8 88	1, 371, 072
Pennsylvania	693, 900	25 82	17, 916, 498	1, 607, 600	3 09	4, 967, 484	937, 200	8 05	7, 544, 460
Delaware	32, 000	25 02	800, 640	35, 000	4 00	140, 000	47, 600	7 70	366, 520
Maryland	120, 400	22 08	2, 658, 432	151, 200	3 65	551, 880	259, 600	5 62	1, 458, 952
Virginia	431, 100	15 93	6, 580, 683	422, 000	2 58	1, 088, 760	759, 200	3 96	3, 006, 432
North Carolina	420, 000	9 56	4, 015, 200	490, 000	1 54	754, 600	1, 180, 000	3 75	4, 425, 000
South Carolina	190, 000	9 82	1, 865, 800	175, 000	1 80	315, 000	450, 000	3 49	1, 570, 500
Georgia	404, 900	8 90	3, 603, 610	382, 300	1 57	600, 211	1, 586, 900	3 29	5, 220, 901
Florida	508, 700	8 07	4, 105, 209	56, 500	1 90	107, 350	190, 000	2 59	492, 100
Alabama	375, 000	9 62	3, 607, 500	270, 000	1 75	472, 500	952, 300	3 26	3, 104, 498
Mississippi	341, 100	10 09	3, 441, 699	250, 000	1 75	437, 500	1, 284, 400	3 34	4, 289, 896
Louisiana	275, 000	10 72	2, 948, 000	125, 000	1 80	225, 000	350, 000	4 11	1, 438, 500
Texas	3, 458, 300	10 30	35, 620, 490	3, 674, 700	2 09	7, 680, 123	1, 716, 700	3 67	6, 300, 289
Arkansas	395, 000	10 93	4, 317, 350	285, 000	1 85	527, 250	1, 040, 300	3 65	3, 797, 095
Tennessee	450, 000	10 61	4, 774, 500	850, 000	1 92	1, 632, 000	1, 900, 000	4 06	7, 714, 000
West Virginia	244, 600	21 50	5, 258, 900	549, 900	2 17	1, 193, 283	281, 500	4 15	1, 168, 225
Kentucky	460, 000	21 69	9, 977, 400	900, 000	2 97	2, 673, 000	1, 950, 000	5 13	10, 003, 500
Ohio	767, 200	24 39	18, 712, 008	3, 783, 000	2 78	10, 516, 740	2, 250, 000	5 86	13, 185, 000
Michigan	389, 700	24 23	9, 442, 431	1, 750, 000	2 53	4, 427, 500	556, 100	6 08	3, 381, 088
Indiana	756, 800	18 15	13, 735, 920	1, 092, 700	2 14	2, 338, 378	2, 422, 500	5 18	12, 548, 550
Illinois	1, 274, 100	21 97	27, 991, 977	1, 258, 500	2 48	3, 121, 080	2, 900, 000	5 89	17, 081, 000
Wisconsin	513, 400	21 12	10, 843, 008	1, 323, 700	2 44	3, 229, 828	635, 300	5 67	3, 602, 151
Minnesota	290, 000	18 61	5, 396, 900	300, 000	2 20	660, 000	180, 000	5 29	952, 200
Iowa	1, 054, 600	19 46	20, 522, 516	560, 000	2 30	1, 288, 000	2, 950, 000	5 42	15, 989, 000
Missouri	1, 075, 000	17 63	18, 952, 250	1, 271, 000	1 82	2, 313, 220	2, 585, 600	4 12	10, 652, 672
Kansas	535, 500	19 14	10, 249, 470	156, 600	2 31	361, 746	431, 700	5 96	2, 572, 932
Nebraska	205, 107	21 30	4, 368, 630	62, 400	2 77	172, 848	255, 700	5 80	1, 483, 060
California	1, 000, 800	17 23	17, 243, 784	6, 561, 000	1 52	9, 972, 720	438, 500	6 27	2, 749, 395
Oregon	176, 600	12 29	2, 170, 414	1, 074, 600	1 76	1, 891, 296	198, 100	3 67	727, 027
Nevada	50, 500	17 56	886, 780	72, 000	2 00	144, 000	10, 800	7 00	75, 600
Colorado	365, 000	16 75	6, 113, 750	600, 000	2 00	1, 200, 000	12, 500	7 50	93, 750
The Territories	500, 000	16 66	8, 330, 000	2, 600, 000	2 30	5, 980, 000	105, 000	7 96	835, 800
Total	19, 223, 300	....	329, 541, 703	35, 740, 500	....	80, 603, 062	32, 262, 500	....	160, 838, 532
Grand average of prices	....	17 14	....	....	2 25	....	....	4 98	....

Table showing the estimated total number and total value of each kind of live stock, and the average price, in January, 1878—Continued.

States.	HORSES.			MULES.			MILCH COWS.		
	Number.	Average price.	Value.	Number.	Average price.	Value.	Number.	Average price.	Value.
Maine	81,700	$62 45	$5,102,165				165,800	$25 28	$4,191,424
New Hampshire	57,100	59 69	3,408,299				95,200	32 50	3,094,000
Vermont	75,900	64 82	4,919,838				217,800	29 25	6,370,650
Massachusetts	132,300	87 46	11,570,958				151,600	40 67	6,165,572
Rhode Island	16,200	93 35	1,512,270				21,000	38 50	808,500
Connecticut	51,500	75 17	3,871,255				112,000	37 50	4,200,000
New York	890,000	80 77	71,885,300	12,000	$88 14	$1,057,680	1,404,100	32 32	45,380,512
New Jersey	114,500	92 12	10,547,740	14,500	108 80	1,577,600	149,200	41 50	6,191,800
Pennsylvania	614,500	72 07	44,840,065	25,700	87 02	2,236,414	836,800	33 52	28,049,536
Delaware	19,900	70 90	1,410,910	4,000	89 76	359,040	23,200	33 50	777,200
Maryland	108,600	68 55	7,444,530	11,200	88 47	990,864	101,500	30 39	3,084,585
Virginia	204,600	62 60	12,807,960	31,200	75 51	2,355,912	240,600	21 29	5,122,374
North Carolina	142,400	67 11	9,556,464	55,300	70 56	3,901,968	230,000	15 47	3,558,100
South Carolina	57,900	80 72	4,673,688	50,000	90 92	4,546,000	130,000	17 50	2,275,000
Georgia	118,300	70 77	8,372,091	96,200	78 81	7,581,522	273,100	16 00	4,369,600
Florida	22,200	70 09	1,555,998	11,800	81 96	967,128	70,700	15 75	1,113,525
Alabama	108,500	58 91	6,391,735	105,400	66 75	7,035,450	205,000	17 00	3,485,000
Mississippi	95,300	65 62	6,253,586	98,000	79 71	7,811,580	186,900	17 82	3,330,558
Louisiana	78,500	53 24	4,179,340	79,100	66 93	5,294,163	112,000	20 37	2,281,440
Texas	725,000	27 45	19,901,250	160,000	44 67	7,147,200	550,000	14 75	8,112,500
Arkansas	165,200	45 23	7,471,996	85,900	57 81	4,965,879	182,200	15 77	2,873,294
Tennessee	327,500	52 91	17,328,025	101,700	56 81	5,777,577	248,200	18 86	4,681,052
West Virginia	117,500	52 32	6,147,600	2,400	57 16	137,184	126,700	26 87	3,404,429
Kentucky	379,300	49 11	18,627,423	119,000	48 58	5,781,020	252,000	28 31	7,134,120
Ohio	765,000	60 74	46,466,100	27,000	64 35	1,737,450	707,000	31 78	22,468,460
Michigan	314,900	73 75	23,223,875	4,200	87 89	369,138	375,600	30 00	11,268,000
Indiana	668,800	51 22	34,255,936	63,100	60 80	3,836,480	439,200	26 70	11,726,640
Illinois	1,091,500	54 84	59,857,860	138,000	63 44	8,754,720	688,600	27 77	19,122,422
Wisconsin	362,600	64 88	23,525,488	8,400	83 10	698,040	450,300	26 43	11,901,429
Minnesota	215,000	66 40	14,726,000	6,100	83 07	506,727	249,800	21 83	5,453,134
Iowa	734,100	56 33	41,351,853	41,400	70 81	2,931,534	632,000	24 55	15,515,600
Missouri	604,800	41 64	25,183,872	190,000	49 73	9,448,700	506,100	21 69	10,977,309
Kansas	236,400	51 34	12,136,776	27,500	65 35	1,797,125	265,000	23 68	6,275,200
Nebraska	116,500	67 68	7,884,720	9,400	92 73	871,662	93,700	26 96	2,526,152
California	262,600	40 94	10,750,844	25,400	68 98	1,752,092	389,500	28 23	10,995,585
Oregon	101,600	48 56	4,933,696	3,500	44 09	154,315	102,200	19 62	2,005,164
Nevada	11,500	52 25	600,875	1,100	70 25	77,275	10,500	30 00	315,000
Colorado	50,000	45 00	2,250,000	5,000	58 50	292,500	55,000	33 00	1,815,000
The Territories	90,000	43 17	3,885,300	24,000	65 50	1,572,000	250,000	24 32	6,080,000
Total	10,329,700		600,813,681	1,637,500		104,323,939	11,300,100		298,499,866
Grand average of prices		58 16			63 70			26 41	

RICE.

Rice culture has not been a very flourishing or permanently prosperous interest in this country. It occupies a very small area, as it always has—being confined in former times almost exclusively to the sea islands and low-lying shore-land of the coast of South Carolina and Georgia.

Its volume of production is an inverted pyramid, in 1840 representing 215 million pounds, 187 millions in 1859, and 73 millions in 1869. Since this date there has been fluctuation and decline up to 1875, when an increase of some 10 millions above the product of 1869 was secured. The crop of 1876 was also a large one, but that of 1877 suffered great diminution in all principal districts.

Although patches of rice have been grown for family use everywhere in Georgia and South Carolina, below the mountain altitudes, the commercial crop is produced exclusively on the sea-coast, nearly all in the counties of Georgetown, Colleton, Charleston, and Beaufort, in the latter, and Camden, Chatham, McIntosh, and Glynn, in the former.

Only a moiety was formerly grown in Louisiana, the only region in which rapid increase is observed of late, but half the crop of the country is now regularly produced upon the old sugar-lands of the lower Mississippi. In fine, conditions heretofore referred to in our reports have not been favorable to its increase either in area or yield on the Atlantic coast, while in the bottom-lands of Southern Louisiana a marked increase has resulted in competition with sugar culture in the same district.

On the Combahee River in South Carolina the present crop is reported as yielding but half as much as last year. On the Santee the yield is said to be but little more than nominal. In the Georgetown district the damage from spring rains was greater than was anticipated. In Georgia the culture was greatly restricted. The leading planters on the Savannah are reported as having placed but half their usual acreage in this crop. On the Ogeechee the area is estimated at 3,000 acres against 5,000 in 1876. In Louisiana the shortage is estimated at nearly 50,000 barrels. At New Orleans the market for the new crop opened with a light demand and easy prices, but the smallness of the receipts caused holders to strengthen their views and to increase their demands. Arrivals at New Orleans for January, 1878, amounted to only 100,427 barrels, a decline of 32,093 barrels compared with the receipts of January, 1877. On the 1st of February the stocks on hand in this market were but 4,000 barrels and 30,000 sacks. Prices were firm at 6½ cents per pound for inferior qualities. There were no choice samples on exhibition, and but very few of the No. 2 grade.

Mr. James R. Sparkman says, concerning the Georgetown district in South Carolina:

As to the peculiarities of the season affecting this crop in this section, I can confidently assure you that the aggregate as well as quality has been largely influenced by a cold, wet spring, and a late, unusually wet harvest. The bulk of the crop was not seeded until June in consequence of heavy freshets in April, which were disastrous to that portion of the crop which had been planted in March and the early part of April. The report of the coming freshets induced a hurried and slovenly putting in of the seed, to be flowed up by the rising water, under the hope that the floods would subside about the time the lands should be dried, and that this portion of the planting would be benefited by the deposit which is always fertilizing to our tide-lands. The early plantings are usually covered with earth, and the lands then flowed for a few days to sprout the grain, after which the lands are kept drained until the crop is fairly set, and then another short flow is given to force a uniform stand. The later plantings are in open trench and the water put on until the grain has sprouted and taken root, when air is given by slacking down to the surface, but holding the surface moist until well rooted. When under "water-culture" the tides are again let on; or if for "dry culture" the lands are drained as low as may be.

Last week all the covered rice which was ready for a dry growth was seriously in-

jured, some entirely destroyed by the freshet, which was accompanied by a tidal wave which submerged fields and embankments so suddenly that many mules and oxen (working stock) were drowned in the fields. This heavy flooding did not subside for many days, and the freshet being protracted it was too late to replant, although it was then known that the crop would be a failure. The June rice promised well, was of good growth, and ripened long before we had any cold weather to injure it. But a succession of rains had been most disastrous to the harvest, affecting not only the quality but causing a waste from dropping or shelling of the grain, in some instances at least 25 to 30 per cent., in a few cases over 50 per cent. There will be but little *prime* from this region, as scarcely an acre has been harvested perfectly dry since the middle of October. That which has been milled thus far confirms this statement.

A letter received from Robert Habersham's Son & Co., a firm of high authority, contains the following statement:

The reason why less was planted this past year was owing to the low prices, which discouraged planters. Rice, like sugar, requires a great outlay. As it turned out, those who planted did well. Labor is becoming steadier and more reliable, and the plantations are getting nearer the order they were in before the war. As this goes on lower prices can be sustained, and if the duty is not disturbed the planters will gradually be able to stand the competition of foreign rice, and the lower price which must come gradually. At present we think the future look is very encouraging if the present duty is not disturbed or is very gradually reduced.

Rice culture has greatly increased in Louisiana since the war, and in some localities it is deemed more profitable than sugar production. Many large plantations now devoted to rice were formerly sugar plantations. Before the war rice was raised only in small patches in the parish of Plaquemines, but it has since extended into various other parishes, especially those having a large area of swamp lands. The crop of 1876 was the largest ever raised in Louisiana, being stated by Boucherau at 176,826 barrels. If the estimates of shortage above cited be not excessive the crop of 1877 will not greatly exceed 125,000 barrels. The loss from high winds is variously estimated at from 15 to 30 per cent. A smaller area was planted on account of the low price of the preceding crop.

Boucherau states the annual production of Louisiana for several years past as follows: 1868, 68,915 barrels, containing 13,783,000 poudds; 1869, 100,748 barrels, or 20,149,600 pounds; 1870, 49,971 barrels, or 9,994,000 pounds; 1871, 30,000 barrels, or 6,000,000 pounds; 1872, 52,206 barrels, or 12,007,380 pounds; 1873, 97,123 barrels, or 19,424,600 pounds; 1874, 104,693 barrels, or 22,338,290 pounds; 1875, 169,264 barrels, or 38,930,720 pounds; 1876, 176,826 barrels, or 40,669,980 pounds. The New Orleans Price Current reports for 1877 a crop represented by 140,785 barrels. In 1849, according to the national census, Louisiana produced 4,425,349 pounds; in 1859, 6,331,257 pounds; in 1869, 15,854,012 pounds, about four-fifths of Boucherau's aggregate for the last year. North Carolina, South Carolina, and Georgia produced in 1849, 204,346,572 pounds of a total of 215,313,497 pounds reported in the census; in 1859 the reported product by thecensus was 179,202,156 pounds, in a total of 187,167,032 pounds; in 1869, 56,641,486 pounds, in a total of 73,635,001 pounds. In North Carolina rice culture is practically restricted to a small area of tide-water lands on the Cape Fear River. Georgetown district, in South Carolina, is the most northerly portion of the tide-lands rice districts of the South, and supplies most of the seed to the other portions of our Southern rice-field.

In 1871 several samples of seed were selected in Georgetown district, South Carolina, for shipment to India, to plant in the rice-fields of that country. Specimens of the produce of that seed were subsequently returned to this department and transmitted to the planters who furnished it. They were surprised to find the seed so changed as to be scarcely recognizable. The influence of climate and soil in rice culture is very remarkable. The experience of the South Carolina planters indicates

that the most northern zone of the rice country produces the heaviest grain.

The main difficulty experienced by these planters is the selection of seed free from "volunteer" or "red" rice. This is the product of the shattered or shelled rice left on the land during harvesting. What the gleaners and birds fail to gather is returned to the soil the following year, when it springs up like the other plants and indistinguishable from them. But the grain from such plants, after a few years, becomes loose in its attachment to the stalk, shells off in hauling or under the action of high winds before harvesting, especially if the crop becomes overripe. Thus this difficulty tends constantly to reproduce itself, a tendency which becomes stronger in proportion to the lack of care in handling the crop. This vicious seed is called "red" rice from the discoloration of the inner pellicle under the chaff. It is at first a pale red, but the discoloration becomes deeper with each generation of the foul seed. It is remarkable that this seed becomes constantly more tenacious to the stalk, so that a parcel of rice polluted with old volunteer seed will require from 25 to 30 per cent. longer time in milling to clear it of these red pellicles.

A great desideratum in rice culture is to secure as uniform a size as possible in the grains. The paddy, for the purpose of hulling, is ground between two stones set very accurately at a specific distance apart, so calculated as to nicely skim the grain without cracking it. The success of this process depends upon the uniformity of the grain. Some of the India specimens of grain from Carolina seed were especially defective in this particular.

Rice culture is embarrassed by several other difficulties, especially want of capital and lack of adaptation to the new conditions of the labor market. Laborers should be permanently enlisted in this branch of production and acquire familiarity with its details. They should be on hand at the proper time to meet the requirements of each stage of culture. The rice-birds will sweep the crop at its ripening if effective protection be withheld. These difficulties are being met in many portions of the rice-field by a more intelligent management and by the employment of a gradually increasing capital. The business will hereafter be prosecuted upon business principles by those who are to make it a paying investment.

The imports and exports for the last ten fiscal years were as follows:

Years.	Imports.		Foreign re-exports.		Domestic exports.		Total exports.	
	Pounds.	Value.	Pounds.	Value.	Pounds.	Value.	Pounds.	Value.
1868	59, 140, 707	$1, 636, 492	11, 908, 953	$403, 941	3, 079, 043	$170, 357	14, 987, 996	$574, 298
1869	53, 065, 191	1, 325, 234	8, 868, 664	284, 632	2, 232, 833	145, 934	11, 101, 497	430, 466
1870	43, 123, 939	1, 007, 612	15, 212, 833	454, 316	2, 133, 014	127, 655	17, 345, 847	581, 971
1871	64, 655, 827	1, 876, 786	10, 212, 920	280, 463	445, 842	22, 502	10, 658, 762	302, 965
1872	74, 642, 631	2, 317, 172	12, 651, 959	378, 996	403, 835	28, 768	13, 055, 794	407, 764
1873	83, 755, 225	2, 304, 696	20, 202, 774	591, 417	276, 637	19, 740	20, 479, 401	611, 157
1874	73, 257, 716	2, 083, 248	25, 840, 877	763, 497	558, 922	27, 075	26, 399, 799	790, 572
1875	59, 414, 749	1, 547, 697	12, 352, 330	342, 894	277, 337	19, 831	12, 629, 667	362, 725
1876	71, 561, 852	1, 693, 547	16, 610, 614	406, 553	439, 991	30, 918	17, 050, 605	437, 471
1877	60, 978, 659	1, 439, 767	14, 483, 645	369, 235	1, 306, 982	78, 112	15, 790, 627	447, 347

FLAX AND FLAX PRODUCTS IN THE UNITED STATES.

Previous to the cheapening and general diffusion of cotton fabrics, consequent upon the invention of the cotton-gin and introduction of cotton factories, the production of flax fiber was almost coextensive with

the settlements. Outside of the cities and of the homes of great planters, there was scarcely a housewife or damsel of whom it might not be said: "She layeth her hands to the spindle, and her hands hold the distaff." From a series of papers written between 1787 and 1791, by Mr. Tench Coxe, Commissioner of the Revenue, and for several years Assistant Secretary of the Treasury, it appears that manufactures from flax and hemp had become an established and very important industry; he enumerates, among articles "manufactured in a household way," seines and nets of various kinds, twine and pack thread, sail-cloth, tow-cloth, white and checked shirtings, sheetings, toweling, table-linen, bed-ticks, hosiery, sewing-thread, and seine-thread lace. Among the flax products "manufactured in a family way" in Massachusetts and Rhode Island, during the first nine months of 1791, Mr. Coxe specifies 25,265 yards of linen cloth. The census of 1810 returned 21,211,262 yards of flaxen cloths made in families; of this, New York produced 5,303,000 yards; Virginia, about 5,000,000; Pennsylvania, 3,000,000; Connecticut, 2,250,000; New Hampshire, 1,000,000; that the same census returned a production of 23,952,746 yards of "blended and unnamed cloths and stuffs," and 802,718 yards of tow-cloth. The census report of 1860, after enumerating various subordinate manufactures from flax or flax-hemp, adds: Although labor-saving machinery for spinning, as well as doubling, trebling, and twisting, was then used to some extent, both by water and steam power, in regular establishments, and some of these had been introduced into families, this extended manufacture of flax and hemp was almost wholly a household industry.

In connection with, and largely as a consequence of, the unusual demand for lint and tow to be consumed in multiform fabrics of house manufacture, sufficient quantities of seed were produced not only for house use and internal commerce, but to leave a large surplus for foreign export. In an official abstract of the exports from the United States for the year ending September 30, 1791, Mr. Coxe specifies 58,492 casks of flax-seed. This is assumed to be equivalent to 292,460 bushels—that is, over half the entire product reported for 1860, and a fraction over one-sixth of that reported for 1870. Among the exports of the same year were 18,600 pounds of lint and 6,850 yards of tow-cloth; but as the manufacture of cotton fabrics in factories increased, this universal household industry, which had greatly contributed toward keeping families at home, united and contented, by affording a profitable employment to both sexes and all ages, gradually declined to a vanishing point. One consequence was that, while the demand for seed was rapidly increasing, production either remained stationary or decreased. No account of the production of flax-seed was taken in the census of 1840, but in 1850 the reported product was 562,312 bushels and the import 667,369 bushels; in 1860, the product 566,867 bushels and the import 2,754,060; in 1870, the product 1,730,444 and the import 4,141,305. In 1875 the import was 6,227,012 bushels. In the eleven States north of the Potomac and east of the Ohio the aggregate reported in 1850 was 122,040 bushels; in 1860, 88,922, production having declined in every one of these States; in 1870, 116,861. The increase was in New York, which had advanced from 56,991 bushels to 92,512, and New Jersey, which had advanced from 3,241 to 6,095. In the remainder of this section the decline continued.

The five States between the Ohio and the Mississippi reported in 1850 238,265 bushels; in 1860, 375,107; 1870, 1,431,415. At these successive decennial periods Ohio reported 88,880 bushels, 242,420, and 631,894; Indiana, 36,888, 119,420, and 401,931; Illinois, 10,787, 8,670, and 280,043.

The States beyond the Mississippi reported in 1850 15,976 bushels; 1860, 11,253; 1870, 143,930. The increase in the product of 1869 over that of 1859 was chiefly in Minnesota, Iowa, California, and Oregon. The great increase of seed in the decade ending with 1870 evidently resulted mainly from the increased demand for fiber occasioned by the war. Hence, since the restoration of the cotton crop and the return of cotton fabrics to nominal prices, the tide has turned in the States east of the Mississippi, and production of seed and lint is again on the decline.

The State of Ohio furnishes definite local statistics, which illustrate the general upward tendency in the northern States east of the Mississippi, beginning with the stimulating effects of the war and continuing until those effects ceased to operate, followed by a gradual decline. From 1862 to 1875, inclusive, the annual acreage and production of seed and lint in Ohio were as follows:

Year.	Acres.	Bushels.	Pounds.	Year.	Acres.	Bushels.	Pounds.
1862	53,488	383,900	2,389,877	1869	88,989	610,758	18,722,776
1863	95,170	624,224	3,582,170	1870	61,204	449,378	16,464,128
1864	61,661	411,102	1,890,032	1871	85,863	733,384	24,447,361
1865	47,875	245,659	3,150,488	1872	72,078	457,379	12,050,638
1866	57,184	467,735	6,597,567	1873	43,650	238,510	5,070,788
1867	98,822	726,517	10,523,876	1874	40,710	268,800	6,623,341
1868	97,820	620,092	12,032,392	1875	33,862	223,653	5,285,417

In the younger States west of the Mississippi the upward tendency in production as yet shows no sign of declining, but seems to grow with accumulating force. Minnesota reported, for 1870, 18,635 bushels of seed and 120,571 pounds of lint; 1872, 71,752 bushels and 2,903,079 pounds; 1873, 100,853 bushels; for 1876 the official estimate was 125,932 bushels. Iowa, which reported for the census of 1870 28,621 bushels, reported for the State census of 1875 559,836 bushels.

In 1875 Kansas had reached 447,864 bushels. This is nearly double the quantity reported for Ohio, the leading State in 1860, and a fraction more than double that of Ohio in 1875. The report of the Kansas State board for 1874 represented that the farmers were in the habit of mortgaging their crops of seed before grown to parties out of the State, and at a price which usually proved to be much below the market price. "The result is, that the crop is sent to Saint Louis or elsewhere, manufactured into oil, and sent back to the State for consumption, with freight, insurance, and commission added both ways."

The report of the Kansas State board for 1875 gives 49,358 acres in flax, yielding 447,864 bushels of seed, valued at $475,455.58. This gives an average yield of 9.07 bushels per acre, and an average value of $1.06 per bushel. The report says:

> This crop is growing in favor with our farmers, not alone for the actual profits of the crop, for they are not large, but because that within about ninety days from the time of sowing they can harvest and market the crop, and at a time when little else from among the growing crops will bring the cash.

FIBER.—The principal causes of fluctuation in production have already been indicated. The amount returned for the census of 1850 was 7,709,676 pounds; 1860, 4,720,145; 1870, 27,133,034. In 1850 Kentucky held the first rank, reporting 2,100,116 pounds; Virginia the second, 1,000,450; New York the third, 940,577; and North Carolina excelled Ohio by 146,864 pounds. In 1860 New York had gained 61 per cent., and held the first rank; Ohio 97 per cent., and was second; Kentucky

had lost 65 per cent., and was third; Virginia 51 per cent., and was fourth. In 1870 Ohio had advanced 1,926.3 per cent., and ranked first; New York 141 per cent., and was second; while Kentucky had lost 67 per cent., and was eighth; and Virginia, including West Virginia, 56 per cent., and was tenth. In New York, as in the Northwest, production which has been declining in recent years appears to have increased until after the close of the war; the product returned in 1869 (the census year) was 92,519 bushels of seed and 3,670,818 pounds of fiber; in 1874, 130,318 bushels and 3,927,914 pounds were returned.

California reported in 1870 31,740 pounds of lint and 13,294 bushels of seed; Oregon, 40,474 pounds and 10,988 bushels. The California State Agricultural Society reported in 1874 that the Pacific Oil and Lint Mills of San Francisco had for some years afforded encouragement to flax culture for the seed. The price paid was 3½ to 4 cents per pound, and at that rate the culture for the seed alone had proved quite remunerative. The same report is authority for the statement that in Oregon the Salem Oil-Mills had promoted the culture by like inducements with like results; also, that the culture of flax for the fiber was receiving encouragement and proving successful.

The State report for 1876 does not return the flaxseed produced, and does not credit any flax to Santa Clara County, but credits to San Benito 761 acres; San Mateo, 125; Santa Barbara, 200; and Santa Cruz, 644; making a total of 1,730 acres, yielding 2,239,800 pounds of lint. This is an average of 1,293 pounds per acre.

MANUFACTURES.

The statistics of flax manufactures, as reported in the census of 1870, are as follows:

Localities.	Kinds of product.	Establishment.	Capital invested.	Value of material used.	Value of product.
Illinois	Dressed flax	5	$35,500	$31,750	$91,400
Indiana	do	1	6,000	3,300	6,000
Michigan	do	1	4,000	2,660	5,700
New Jersey	do	3	6,000	24,000	33,300
New York	do	46	189,780	166,545	284,385
Ohio	do	27	240,900	136,509	346,405
Oregon	do	1	8,571	225	4,300
Pennsylvania	do	3	16,450	10,155	22,020
Vermont	do	1	2,500	1,540	2,500
Wisconsin	do	2	15,000	5,850	19,000
Total		90	524,701	382,534	815,010
Massachusetts	Flax and linen goods	3	982,000	336,170	790,250
Michigan	do	1	4,500	865	1,225
New Hampshire	do	1	93,750	132,000	175,000
New Jersey	do	1	140,500	115,796	246,986
New York	do	2	80,000	96,562	163,900
Pennsylvania	do	1	15,000	2,400	12,000
Rhode Island	do	1	1,000,000	128,000	374,400
Total		10	2,315,750	811,793	1,763,761
Illinois	Bagging	2	125,000	136,000	290,000
Missouri	do	2	1,200,000	*423,100	750,000
Ohio	do	7	348,500	†289,053	563,799
Total		11	1,673,500	848,153	1,603,799

Localities.	Kinds of product.	Establishment.	Capital invested.	Value of material used.	Value of product.
Connecticut	Linseed-oil	1	23, 500	20, 500	30, 000
Illinois	......do	9	545, 500	924, 282	1, 154, 033
Indiana	......do	7	386, 000	534, 969	600, 912
Iowa	......do	4	142, 500	199, 530	240, 338
Kentucky	......do	1	80, 000	70, 000	78, 000
Maryland	......do	2	145, 000	371, 400	478, 125
Massachusetts	......do	2	200, 000	914, 000	1, 003, 610
Michigan	......do	1	26, 000	10, 000	19, 200
Minnesota	......do	1	80, 000	43, 328	58, 141
New Jersey	......do	1	12, 000	9, 000	10, 700
New York	......do	9	576, 600	2, 141, 360	2, 763, 455
Ohio	......do	23	1, 090, 967	1, 537, 290	1, 840, 040
Oregon	......do	1	51, 439	16, 750	30, 900
Pennsylvania	......do	15	716, 100	798, 583	1, 043, 534
Tennessee	......do	1	450	300	525
Vermont	......do	1	10, 000	25, 000	32, 000
Virginia	......do	1	400	350	540
Wisconsin	......do	1	25, 000	35, 000	64, 175
Total		81	4, 111, 456	7, 651, 642	9, 448, 228
Grand total		92	8, 625, 407	9, 694, 122	13, 630, 798

*Nearly 23 per cent. of the material is hemp. †The material is exclusively tow.

It should be borne in mind that some portion of the material used in the production of flax and linen goods was imported; also that the value of the products of dressed flax is reported in the value of flax and linen goods produced.

The manufacture of linseed-oil in the sea-coast region, mainly from imported seed, has greatly increased in twenty years, but its most rapid advance was between 1850 and 1860.

The amounts and values are as follows:

States.	1870.		1860.	1850.
	Gallons.	Value.	Value.	Value.
New York	1, 844, 900	$2, 002, 425	$2, 513, 874	$514, 670
Ohio	1, 215, 299	1, 565, 149	759, 604	448, 455
Illinois	804, 444	806, 644	....	4, 600
Massachusetts	791, 000	715, 900	957, 500	297, 500
Pennsylvania	738, 850	788, 450	1, 033, 083	313, 704
Indiana	492, 846	465, 473	81, 702	38, 725
Maryland	360, 000	330, 250	237, 000	8, 900
Iowa	208, 000	198, 000	18, 100	....
Missouri	160, 000	150, 000	43, 000	65, 000
Kentucky	60, 000	60, 000	32, 000	106, 000
Other States	67, 391	157, 485	309, 980	222, 380
United States	6, 819, 730	7, 239, 773	5, 985, 843	1, 948, 934

The imports of flax products were comparatively uniform from 1850 to 1865, with the exception of those of 1862. Those of 1857 were the largest of this period. They averaged less than $10,000,000 per annum during the first year of the war, which was less than those of any similar period between 1850 and 1860. Since 1865 the average value of imports has doubled. The following is a complete enumeration of all such imports in detail, compiled from official reports of the Treasury.

Imports of flax and flax products.

Years.	Raw flax.		Tow.		Linens.	Not specified.	Linseed oil.		Flaxseed.		Total value.
	Cwt.	*Dollars.*	*Cwt.*	*Dollars.*	*Dollars.*	*Dollars.*	*Gallons.*	*Dollars.*	*Bushels.*	*Dollars.*	*Dollars.*
1877	89, 960	1, 243, 064	....	....	11, 509, 894	2, 406, 008	....	....	1, 445, 625	1, 916, 249	17, 075, 217
1876	73, 180	1, 060, 437	....	....	§12, 227, 936	2, 218, 110	....	....	2, 755, 726	3, 859, 496	19, 365, 979
1875	86, 440	1, 112, 405	....	....	§14, 124, 947	2, 478, 295	....	....	3, 783, 344	6, 227, 012	23, 942, 659
1874	68, 520	942, 038	....	....	14, 081, 428	3, 391, 327	....	....	2, 648, 321	4, 301, 690	22, 716, 483
1873	83, 420	1, 137, 737	....	....	§16, 271, 590	4, 156, 801	....	....	2, 453, 428	3, 854, 461	25, 420, 589
1872	105, 480	1, 399, 747	....	....	§16, 615, 066	4, 605, 430	....	....	2, 936, 421	4, 318, 030	26, 938, 273
1871	73, 440	694, 832	....	....	§13, 560, 702	4, 500, 393	....	....	....	5, 160, 547	23, 916, 474
1870	38, 540	605, 962	....	....	§12, 716, 656	3, 547, 796	....	....	....	4, 141, 304	21, 011, 718
1869	39, 060	669, 411	....	....	§13, 990, 341	2, 562, 546	....	....	....	1, 543, 443	18, 765, 741
1868	....	593, 334	....	24, 777	§11, 956, 156	1, 474, 587	900, 038	580, 248	2, 267, 178	3, 311, 992	17, 941, 094
1867	21, 540	474, 912	9, 880	93, 816	§18, 522, 876	1, 941, 999	3, 207, 803	2, 123, 350	1, 769, 192	2, 638, 465	25, 795, 418
1866	32, 380	659, 906	....	134, 245	§21, 825, 307	1, 975, 907	1, 161, 909	746, 571	1, 516, 683	1, 885, 103	27, 227, 039
1865	28, 332	369, 359	....	145, 449	§8, 845, 290	1, 324, 379	52, 388	32, 347	951, 593	1, 228, 761	11, 945, 585
1864	32, 994	484, 996	....	....	§8, 344, 643	1, 430, 196	317, 427	196, 496	1, 046, 718	1, 421, 622	11, 877, 953
1863	*30, 324	433, 863	....	8, 438	6, 348, 823	1, 575, 410	33, 822	20, 667	1, 268, 554	1, 712, 408	10, 099, 609
1862	*13, 866	185, 326	....	1, 593	2, 894, 314	1, 064, 376	51, 212	33, 531	383, 211	513, 585	4, 692, 725
1861	....	†215, 104	1, 080	9, 027	§6, 961, 303	1, 030, 127	186, 347	123, 538	....	2, 073, 945	10, 413, 044
1860	....	213, 687	156	438	9, 245, 816	1, 490, 519	576, 495	402, 908	....	2, 754, 060	14, 107, 428
1859	....	146, 707	33	179	8, 958, 977	1, 381, 628	1, 210, 697	695, 172	....	2, 415, 792	13, 598, 455
1858	....	197, 934	4, 191	29, 691	5, 598, 571	958, 752	282, 842	164, 757	....	3, 243, 174	10, 192, 876
1857	22, 231	220, 738	‡18, 721	92, 520	9, 975, 338	1, 466, 204	1, 465, 865	958, 200	2, 730, 359	3, 003, 824	15, 716, 824
1856	15, 324	132, 461	‡1, 159	11, 271	9, 849, 600	1, 339, 863	1, 712, 208	1, 063, 771	1, 696, 294	1, 741, 260	14, 128, 226
1855	28, 961	286, 809	‡3, 043	19, 503	7, 552, 865	1, 064, 300	1, 243, 035	776, 097	1, 102, 545	1, 009, 381	10, 708, 955
1854	23, 201	250, 391	‡3, 178	21, 258	9, 437, 846	1, 425, 690	1, 456, 611	775, 058	1, 111, 721	928, 140	12, 838, 383
1853	13, 553	135, 684	‡3, 576	16, 931	8, 897, 317	1, 338, 720	1, 912, 523	1, 045, 897	867, 580	633, 395	12, 067, 944
1852	28, 234	175, 342	‡6, 127	35, 717	7, 603, 603	912, 106	1, 583, 012	779, 054	885, 007	589, 749	10, 095, 571
1851	21, 171	176, 197	‡4, 742	15, 887	7, 748, 623	1, 047, 117	2, 818, 344	1, 632, 811	602, 074	430, 017	11, 050, 652
1850	14, 474	128, 917	‡6, 190	32, 421	7, 063, 184	1, 071, 490	1, 513, 117	848, 672	667, 369	324, 811	9, 469, 495

* Including tow. † Including hemp and flax and tow thereof, worth $25,890. ‡ Tow of flax and hemp.

§ Including brown hollands, burlaps, canvas, coatings, crash, diaper, duck, handkerchiefs, huckabacks, lawns, paddings, and all like manufactures of which flax, jute, or hemp shall be the material of chief value.

The only domestic product of flax exported in recent years in quantity worthy of notice is oil-cake. The export of that amounted in value, in 1860, to $1,609,328; in 1870, to $3,419,288; in 1875, to $5,138,300.

The exports aggregate a very small amount, with the sole exception of the item of oil-cake, which now makes a very respectable figure.

Value of the exports of flax and its manufactures from the United States.

	1850.	1860.	1870.
Foreign.			
Raw:			
Manufactures, by the yard	$110, 551	$119, 416	$13, 602
Other manufactures	19, 327	61, 195	121, 970
Flaxseed or linseed		4, 395	
Linseed oil	1, 300	2, 639	
Oil-cake			13, 304
Domestic.			
Flaxseed	4, 040	3, 810	120
Manufactures of	11, 776		
Linseed oil		26, 799	22, 913
Oil-cake		1, 609, 328	3, 419, 288
Total	146, 994	1, 827, 582	3, 591, 197

FLAX FIBER FOR BAGGING.—About the time the war closed a promising industry was commenced at Saint Louis and its vicinity in manufacturing bagging from coarse flax fiber. The following account of its rise, progress, and decline is principally gathered from statements of the trade and commerce of Saint Louis by the Merchants' Exchange. Receipts of flax tow, mostly for home consumption in manufacturing bagging, were first separately reported in 1867, when they amounted to 3,169 bales. There was an annual increase up to 1872, when they reached 17,369. In 1873 they declined to 14,160; in 1874, to 1,124.

The report for 1868 represented that bagging made of flax tow, wherever tried, was used in preference to the imported. That for 1869 said, "As great improvements have been made in the machinery employed in the manufacture of both hemp and flax, it is confidently predicted by some engaged in the trade that, if the rate of duty on foreign bagging is left as it is at present, within a year or two bagging made in this country will be exclusively used." It was estimated in the same report that the flax fiber grown in the West annually equaled 75,000,000 pounds, less than one-fifth of which was utilized. The great difficulty in the way of utilizing this raw material is the cheapness of imported jute, which, though having only half of the tensile strength of flax, can crowd it from the market if unprotected, since it is grown where labor costs not over ten cents per day, and is shipped to Boston and New York from Calcutta at less cost than flax fiber can be from Saint Louis. Complaint is made that since the close of the war and decline in the price of gold, such importations had already nearly destroyed a rising industry in manufacturing flax fibers in the Eastern States, and consequently a rising market for flax fiber grown in the West. The report concludes by affirming that the Western farmer needs a little encouragement in the way of profitably utilizing this vast product of intrinsic value, now wasted, and, "in justice to this section of our country, demands that no adverse legislation be allowed to interfere with the full development of this great agricultural interest."

The report for 1870 states that within three years more than twenty

factories, principally in the West, had been put in operation for manufacturing bagging from flax tow, having a capacity for 15,000,000 yards per annum, a quantity sufficient for covering 2,250,000 bales of cotton. It also claims that the business operations of that year had conclusively settled the point that bagging from flax tow takes precedence of all other kinds, for these reasons: it is the strongest, will not rot so quickly from exposure as other kinds, and, in proportion to weight and quality, is the cheapest.

But, notwithstanding this promising outlook, jute, for a time at least, has superseded both flax and hemp in the increasing manufactures of bagging at Saint Louis. The first receipt of jute reported was 10,325 bales in 1874. This was increased to 21,109 in 1875, and 30,542 in 1876. The product of bagging at Saint Louis in the latter year was 6,500,000 yards.

RECENT LOCAL STATISTICS.—Local information from many of the principal flax counties has been received during 1877, from which it appears that production is not at present advancing, except in the more Western States, in which experiments by new settlers are being tried with some success.

In Kansas a marked advance is noted since 1870. In 1859 there were reported 1,135 pounds of fiber and 11 bushels of seed. In 1870 the record stood 1,040 pounds and 1,553 bushels. In 1876, by the State returns, nearly every county in the State reported seed for oil-making, aggregating 501,981 bushels, grown on 59,138 acres, the crop valued at $802,237. Yield per acre, 8.4 bushels.

Minnesota in 1859 reported but 118 bushels of seed and 1,985 pounds of fiber; in 1869, 18,635 bushels of seed and 122,571 pounds of fiber. The State record of 1874 shows an area of 19,715 acres in flax, yielding 109,043 bushels of seed, or 5.5 bushels per acre. The crop of 1875 averaged 7.56 bushels per acre, though nearly one-sixth was damaged by grasshoppers, the estimated loss being 22,635 bushels from this cause; the crop gathered 125,932 bushels.

Iowa is credited with 695,518 pounds of fiber in 1869 and 88,621 bushels of seed. The product of seed in 1876 is estimated in the State report at 725,000 bushels. Johnson, Linn, Benton, and Black Hawk are counties prominent in this industry.

These figures contrast with the decline exhibited in more eastern States, as Ohio, where the product of seed has fallen from 733,384 in 1871 to 284,029 in 1876, and the fiber from 24,477,361 to 3,812,397 pounds.

The products of Ohio flax, and their comparative amount and value, are seen in detail in local reports, as follows:

Clark: The products of the flax-mill are not stated. The oil-mill produces 100,000 gallons of oil, worth 55 cents per gallon, and 1,000 tons of oil-cake. *Wayne* consumes 400 tons of flax and produces 150 tons of tow worth $6,000. *Warren:* The fiber utilized is sold to paper-makers. The seed is shipped. No farmer raises flax as a specialty or every year. *Montgomery* produces 85,000 gallons of oil, worth 60 cents per gallon. Two flax-mills produce tow for upholsterers. *Trumbull* produces 140,000 gallons of oil from home and western seed, worth 62 cents per gallon, and 1,400 tons of oil-cake, worth $18 per ton, and cloth for baling cotton marketed at the South. *Portage:* The largest flax-mill in operation a few years ago has failed. The market for seed and fiber was too far away and though the crop paid well it was thought to be exhausting to the land; and now one may travel hundreds of miles in the county and not see a flax-field. *Ashland:* A product of 2,250 tons of straw is all utilized in manufacturing coarse fiber. *Delaware:* Under government protection the flax industry increased rapidly. In 1873 the product was 27,620 bushels of seed and about 1,000 tons of straw, 80 per cent. of which was manufactured into tow. "But the withdrawal of government protection has knocked the flax industry in the head completely." The price of the straw has fallen more than 50 per cent., and consequently less than half is now utilized. Of the 4 flax-mills formerly in operation, the 3 smaller ones run about one-fourth of the time, producing tow which

now sells for only 2½ cents per pound. The largest one has been converted into a factory for manufacturing imported jute into bagging. *Hancock* produces 60,000 gallons of oil, worth 60 cents; 600 tons of oil-cake, worth $33 per ton; 120 tons of tow and lint (from 325 tons of straw), worth $60 per ton.

In *Carroll County*, Indiana, flax straw was worth, in 1877, $4 to $6 per ton in manufacturing tow, of which 200 tons were used. The price in *Huntington* ranged from $4 to $7. In *Will County*, Illinois, a correspondent says that "the last census reported 10,717 bushels of seed, but now there is not enough grown to be worthy of mention." *Joe Daviess* is credited with a product of 400,000 pounds of tow, selling by the bale at 2½ cents per pound. *Kankakee* produces 3,000 barrels of oil and 1,600 tons of oil-cake. *De Kalb* utilizes a portion of tow for upholstering, at $40 per ton. The flax crop is favorably regarded by one reporter in *Will County* as a preparation for wheat, reducing the labor of "putting in" 25 per cent.

Johnson County, Iowa, "produces 80,000 gallons of oil, and 800 tons of oil-cake, worth $32 per ton, and furnishes stock for a paper-mill" and for rope-making. *Marshall* makes 100,400 gallons of oil, and 1,104 tons oil-cake, which was sold last season for $30 per ton.

The price for seed varies with the distance from mills and the sharpness of mill-proprietors in making contracts for seed grown from seed furnished. In *Rensselaer County*, New York, the price last reported was $1.60 per bushel; $1.40 in *Yates*. In Ohio last year the range is from 90 cents in *Preble* to $1.50 in *Warren* and *Morrow*, $1.35 in *Wayne*, $1.30 in *Delaware*, $1.25 in *Trumbull*, *Williams*, and others, $1.10 in *Hancock*, $1 in *Shelby*. In Indiana there is a similar range—from 90 cents in *Wabash* to $1.50 in *Carroll*; in Illinois, from 90 cents in *Ford* to $1.40 in *Cook*. In Iowa the lowest reported price is $1.10 in *Johnson*, the highest $1.33 in *Marshall*. *Rensselaer County*, in New York, the seat of linen industry in this country, still produces and manufactures lint. There were reported last year twenty mills for dressing flax and two for manufacturing yarn and twine. The latter consume 3,000 pounds of fiber daily when running on full time. Much of the fiber used here is imported from Canada and Europe at rates cheaper than farmers here are willing to supply it. The yield of the native product is about 300 pounds of lint and 100 of tow. A mill is mentioned in *Herkimer* which uses but 40 tons annually, valued at $8 per ton, and employs only two hands, cheese-dairying having almost entirely superseded flax culture.

Among the obstacles in the way of profitably growing the fiber are the following: First, the want of a regular and accessible market. Second, the labor involved in pulling flax on a large scale is greater than can be secured at the proper season at wages which will leave any margin for profit. Third, the process of "rotting" or eliminating the fiber from the stalk "in the old-fashioned way" is tedious and thought to be unhealthy. Fourth, most farmers do not sufficiently understand the rotting part of this process, and are therefore very liable to injure the fiber by some failure, either in method or degree. Fifth, the processes of breaking, scutching, and hackling by hand are very disagreeable, necessarily involving the operator in an atmosphere thick with dust and dirt, and yet requiring skilled workmen, such as it is often quite impracticable to secure. Sixth, owing to the cheapness of labor in Europe, it is impracticable to compete with European production without more protection by legislation than is at present granted. The complaint is made that flax-growing has received much less legislative encouragement than either wool or silk.

But whatever of weight may be attached to this list of discourage-

ments, they were all to be met and overcome in European production, except that of higher-priced labor, which may in part be counterbalanced in this country by cheaper real estate, both for production and for manufactures, cheaper water-power, fuel, machinery, &c.

The existing rate of duty on flax and its productions is as follows: Flax straw, $5 per ton; flax not hackled or dressed, $20; hackled, known as dressed line, $40; tow, $10; brown and bleached linens and other manufactures of flax, or of which flax shall be the component material of chief value, valued at 30 cents or less per square yard, 35 per cent. ad valorem; valued above 30 cents per square yard, 40 per cent. ad valorem; flax or linen yarns, threads, twines, &c., 30 to 40 per cent. ad valorem, according to value per pound, &c.; flax-seed 20 cents per bushel of 56 pounds; flaxseed oils, 30 cents per gallon of 7½ pounds.

OUR AGRICULTURAL EXPORTS.

In the Report of Agriculture for 1862 a compilation from the official reports was made by the undersigned of the distinctively agricultural exports of thirty-seven years. A similar compilation and analysis has been continued since, until the record extends to fifty-two years.

These exports are divided into five classes: Animals and their products, breadstuffs, cotton (including its manufactures), wood, and miscellaneous products. Necessarily the extension of raw materials, as manufactured meat-products, lumber, vegetable oils, must be considered, and the direct manufacture of a single and uncombined product of the farm, to render it available for exportation, was deemed for this purpose an agricultural product.

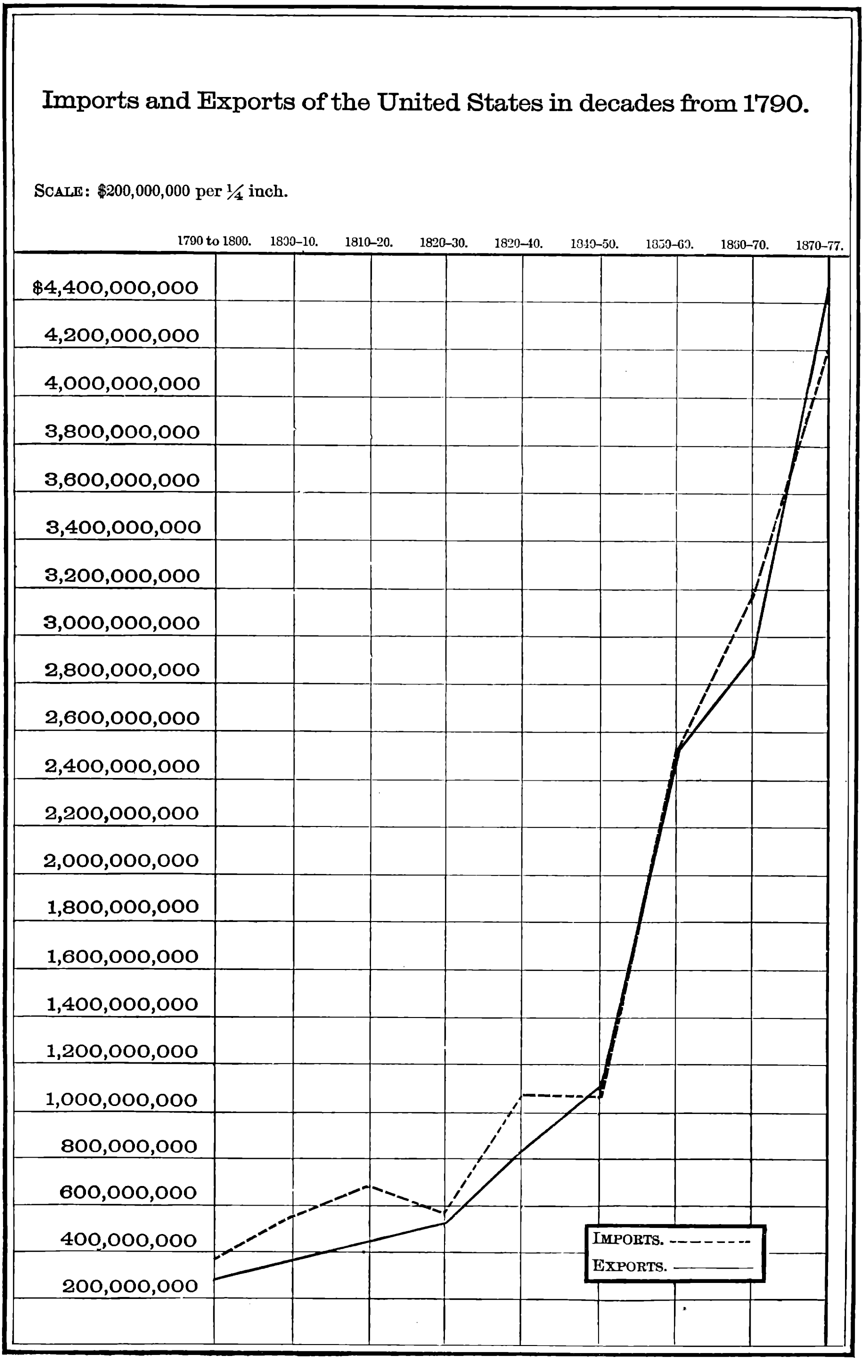
A recapitulation of the facts of this exportation will be more intelligible and satisfactory if they are grouped in periods of five years. The figures are the average per annum for each period:

Periods.	Animals and their products.	Breadstuffs, &c.	Cotton, &c.	Wood, &c.	Miscellaneous.	Average annual aggregate.
1826-1830	$4,602,375	$8,472,623	$27,801,516	$3,126,501	$6,568,375	$50,571,390
1831-1835	4,873,044	9,619,072	43,489,612	3,490,600	7,569,751	69,042,079
1836-1840	4,061,852	9,422,982	67,312,345	4,008,762	10,482,429	95,288,370
1841-1845	6,779,297	10,341,102	54,678,009	3,866,231	10,429,520	86,094,159
1846-1850	12,694,772	28,446,477	63,915,365	4,076,636	9,799,988	118,933,238
1851-1855	13,579,737	26,836,313	105,247,092	6,049,727	15,438,588	167,151,457
1856-1860	20,844,187	40,609,279	156,514,271	12,270,881	26,531,647	256,770,265
1861-1865	51,311,851	72,820,959	17,017,960	11,069,359	34,171,187	186,391,316
1866-1870	35,434,754	55,262,657	209,250,210	16,405,155	34,920,511	351,273,287
1871-1875	85,560,083	107,228,367	208,818,938	22,730,065	40,376,374	464,713,827

The advance has been remarkable, progress without a faltering step, except in the period following the great financial depression which resulted from the great monetary crash of 1837, when the exports of cotton greatly declined. The average for the last of these ten periods is nearly ten times that of the first.

The rapid increase of our foreign trade illustrates strikingly the progress of population and industry. Diagram 10 represents the course of exports and imports, by decades, from 1790 to the present time.

DIAGRAM X.



M. JOYCE, WASHINGTON.

Statement of the exports of agricultural products of the United States, with their immediate manufactures, for the two fiscal years ending June 30, 1877, compiled from the Treasury Report of Commerce and Navigation.

Products.	1876.		1877.	
	Quantity.	Value.	Quantity.	Value.
Animals, living:				
Hogs ..... number..	68, 044	$670, 042	65, 107	$699, 180
Horned cattle ..... do....	51, 593	1, 110, 703	50, 001	1, 593, 080
Horses ..... do....	2, 030	234, 964	2, 042	301, 134
Mules ..... do....	1, 784	224, 860	3, 441	478, 434
Sheep ..... do....	110, 312	171, 101	179, 017	234, 480
All other, and fowls	.....	24, 617	.....	18, 895
Animal matter:				
Bone-black, ivory-black, &c ..... pounds..	686, 635	29, 271	584, 134	28, 711
Bones and bone dust ..... cwt..	40, 432	69, 159	70, 720	121, 493
Candles ..... pounds..	1, 513, 475	229, 311	1, 616, 163	234, 408
Furs and fur-skins	.....	4, 398, 883	.....	3, 836, 579
Glue ..... pounds..	24, 288	5, 798	157, 246	30, 679
Hair—				
Unmanufactured	.....	310, 761	.....	338, 487
Manufactures of	.....	6, 254	.....	35, 506
Hides and skins other than furs	.....	2, 905, 921	.....	3, 113, 883
Sorts not specified ..... pounds..	31, 947, 001	8, 394, 580	25, 122, 936	6, 016, 373
Morocco and other fine	.....	948, 980	.....	1, 280, 225
Boots and shoes ..... pairs..	263, 509	368, 633	382, 650	548, 472
Saddlery and harness	.....	87, 730	.....	94, 085
Other manufactures	.....	209, 062	.....	742, 300
Oil—				
Lard ..... gallons..	146, 323	140, 156	347, 305	281, 551
Other animal ..... do....	22, 631	24, 498	19, 932	19, 720
Provisions—				
Bacon and hams ..... pounds..	327, 730, 172	39, 664, 456	460, 057, 146	49, 512, 412
Beef, fresh ..... do....	.....	.....	49, 210, 990	4, 552, 523
Beef salted ..... do....	36, 596, 150	3, 186, 304	39, 155, 153	2, 950, 952
Butter ..... do....	4, 644, 894	1, 109, 496	21, 527, 242	4, 424, 616
Cheese ..... do....	97, 676, 264	12, 270, 083	107, 643, 300	12, 729, 615
Condensed milk	.....	118, 549	.....	123, 801
Eggs ..... dozen..	37, 807	8, 300	37, 606	9, 733
Lard ..... pounds..	168, 405, 839	22, 429, 485	234, 741, 233	25, 562, 665
Mutton, fresh ..... do....	.....	.....	349, 368	36, 480
Pork ..... do....	54, 195, 118	5, 744, 022	69, 671, 894	6, 296, 414
Preserved meats	.....	998, 052	.....	4, 547, 310
Soap—				
Perfumed and toilet	.....	11, 007	.....	11, 549
All other ..... pounds..	10, 057, 478	673, 732	10, 196, 939	631, 778
Tallow ..... do....	72, 432, 775	6, 734, 378	91, 472, 803	7, 883, 616
Wax ..... do....	218, 610	69, 127	307, 091	93, 521
Wool—				
Raw and fleece ..... do....	104, 768	13, 845	2, 213, 370	696, 454
Carpets ..... do....	8, 315	6, 586	23, 479	16, 377
Other manufactures	.....	329, 803	.....	436, 566
Total value of animals and animal matter.	.....	113, 941, 509	.....	140, 564, 066
Breadstuffs and other preparations:				
Barley ..... bushels..	317, 781	210, 586	1, 186, 129	708, 541
Bread and biscuits ..... pounds..	12, 066, 469	632, 580	11, 955, 907	631, 592
Corn ..... bushels..	49, 493, 572	33, 265, 280	70, 860, 983	41, 621, 245
Corn meal ..... barrels..	354, 240	1, 305, 027	447, 907	1, 511, 152
Oats ..... bushels..	1, 466, 228	588, 583	3, 071, 403	1, 229, 774
Rye ..... do....	543, 841	480, 083	2, 189, 322	1, 822, 766
Rye flour ..... barrels..	7, 553	39, 054	7, 989	41, 633
Wheat ..... bushels..	55, 073, 122	68, 382, 899	40, 431, 624	47, 256, 417
Wheat flour ..... barrels..	3, 935, 512	24, 433, 470	3, 343, 665	21, 663, 947
Other small grain and pulse	.....	1, 136, 515	.....	904, 338
Other preparations of grain	.....	707, 478	.....	650, 206
Rice ..... pounds..	439, 991	30, 918	1, 377, 244	85, 349
Total value of breadstuffs, &c	.....	131, 212, 471	.....	118, 126, 960
Cotton and its manufactures:				
Sea Island ..... pounds..	2, 644, 791	941, 803	3, 394, 724	1, 084, 509
Other unmanufactured ..... do....	1, 488, 760, 543	191, 717, 459	1, 441, 974, 406	170, 033, 999
Colored goods ..... yards..	16, 488, 214	1, 455, 462	29, 601, 304	2, 484, 131
Uncolored ..... do....	59, 319, 267	5, 314, 738	76, 769, 147	6, 437, 223
All other manufactures	.....	952, 778	.....	3, 213, 386
Total value of cotton, &c	.....	200, 382, 240	.....	183, 253, 248

Statement of the exports of agricultural products of the United States, &c.—Continued.

Products.	1876.		1877.	
	Quantity.	Value.	Quantity.	Value.
Wood and its products:				
Boards, planks, joists, &c ....M feet..	252, 407	$3, 862, 793	321, 530	$5, 434, 922
Laths, palings, pickets, &c...........M..	5, 675	16, 501	4, 992	16, 800
Shingles ....M..	33, 636	130, 847	38, 327	126, 632
Box-shooks	....	105, 796	....	305, 201
Other shooks, staves, and headings	....	4, 322, 252	....	3, 948, 739
Hogsheads and barrels, empty..number..	152, 228	349, 456	136, 724	255, 911
All other lumber	....	321, 790	....	846, 410
Fire-wood ....cords..	3, 032	9, 029	3, 073	9, 518
Hop, hoop, telegraph, and other poles	....	476, 312	....	413, 321
Logs, masts, spars, and other whole timber	....	616, 197	....	499, 822
Timber, sawn and hewn......cubic feet..	21, 786, 414	3, 463, 352	20, 640, 259	3, 124, 412
All other timber	....	138, 553	....	60, 059
Household furniture	....	1, 574, 935	....	1, 700, 412
Wooden ware	....	342, 860	....	328, 839
All other manufactures	....	1, 565, 602	....	1. 373, 039
Ashes, pot and pearl.............pounds..	1, 309, 861	75, 597	991, 845	56, 202
Bark for tanning	....	223, 276	....	67, 290
Rosin and turpentine............barrels..	824, 256	2, 188, 673	905, 936	2, 402, 018
Spirits of turpentine ....gallons..	5, 178, 934	$1, 672, 068	6, 843, 029	$2, 293, 009
Tar and pitch ....barrels..	69, 138	164, 647	72, 189	160, 410
Total value of wood, &c	....	21, 620, 486	....	23, 422, 966
Miscellaneous:				
Brooms, brushes, &c	....	198, 914	....	172, 000
Cordage, ropes, twines of all kinds..lbs..	2, 126, 524	271, 090	2, 705, 441	341, 600
Fruits—				
Apples — Dried ....pounds..	713, 840	67, 915	14, 318, 052	920, 292
Apples — Green or ripe ..bushels..	177, 298	221, 764	1, 146, 929	986, 112
Other green, ripe, or dried	....	210, 177	....	494, 427
Preserved in cans or otherwise	....	327, 422	....	762, 344
Ginseng ....pounds..	550, 624	646, 954	440, 406	562, 268
Hay ....tons..	7, 528	134, 017	7, 457	120, 293
Hemp, unmanufactured ....cwt..	870	8, 318	1, 467	12, 182
Cables and cordage ....cwt..	11, 200	147, 009	13, 072	175, 750
All other manufactures	....	737, 042	....	719, 809
Hops ....pounds..	9, 191, 589	1, 384, 521	9, 587, 329	2, 306, 537
Liquors, alcoholic, cider, and beer—				
Ale and porter—				
In bottles ....dozen..	7, 045	13, 007	37, 876	51, 077
In casks ....gallons..	99, 310	29, 657	155, 277	42, 488
Spirits distilled from—				
Grain ....gallons..	130, 381	93, 666	1, 008, 741	489, 174
Molasses ....do....	1, 088, 133	457, 259	647, 331	285, 979
Other materials ....do....	264	766	4, 224	10, 174
Wine..........................do....	31, 915	33, 483	99, 539	68, 277
Oil-cake ....pounds..	287, 119, 800	5, 774, 585	273, 676, 873	4, 818, 923
Oil—				
Cotton-seed.................gallons..	281, 054	146, 135	1, 705, 422	842, 248
Linseed ....do....	30, 331	23, 770	59, 495	43, 435
Essential or volatile	....	248, 270	....	448, 057
Seeds—				
Cotton ....pounds..	5, 164, 546	69, 605	10, 309, 294	130, 062
Flax or lint ....bushels..	98	257	3	8
All other	....	1, 348, 750	....	3, 438, 450
Starch ....pounds..	9, 685, 552	524, 956	9, 688, 952	462, 234
Sugar—				
Brown ....pounds..	22, 714	2, 354	85, 838	6, 618
Refined ....do....	51, 840, 977	5, 552, 587	54, 315, 349	6, 198, 139
Molasses ....gallons..	4, 408, 412	1, 158, 585	3, 157, 923	849, 877
Candy and confectionery	....	32, 245	....	61, 892
Tobacco—				
Leaf ....pounds..	218, 310, 265	22, 737, 383	282, 386, 426	28, 825, 521
Cigars ....M..	707	23, 407	1, 150	38, 161
Snuff ....pounds..	10, 551	4, 793	2, 533	1, 968
Other manufactures	....	2, 804, 955	....	3, 213, 393
Vegetables, &c.—				
Onions ....bushels..	61, 816	54, 015	52, 328	48, 081
Pickles and sauces	....	19, 086	....	48, 523
Potatoes ....bushels..	704, 379	431, 443	529, 650	533, 187
All other	....	133, 272	....	116, 518
Vinegar ....gallons..	19, 325	6, 133	24, 073	6, 641
Total value of miscellaneous products..	....	46, 079, 567	....	58, 652, 719

Statement of the exports of agricultural products of the United States, &c.—Continued.

RECAPITULATION.

Products.	1871.	1872.	1873.	1874.
Animals and animal matter	$47,010,312	$77,060,849	$99,806,599	$99,697,669
Breadstuffs, &c	79,519,387	85,155,523	98,762,891	161,225,939
Cotton, &c	221,885,245	182,988,925	230,190,597	214,319,420
Wood, &c	15,820,029	21,425,068	25,854,120	27,675,300
Miscellaneous	33,060,081	40,139,296	37,901,458	45,486,626
Total agricultural exports	397,205,054	406,769,661	492,515,665	548,314,954
Total exports	562,518,651	549,219,718	649,132,563	693,039,066
Per cent. of agricultural matter	70	74	76	79

Products.	1875.	1876.	1877.
Animals and animal matter	$104,314,988	$113,941,509	$140,564,066
Breadstuffs, &c	111,478,096	131,212,471	118,126,940
Cotton, &c	194,710,507	200,383,240	183,253,248
Wood, &c	22,875,814	21,620,486	23,422,966
Miscellaneous	45,294,411	46,079,567	58,652,719
Total agricultural exports	478,673,816	513,236,273	524,019,939
Total exports	643,094,767	644,956,406	689,167,390
Per cent. of agricultural matter	74	79	76

The value of agricultural exports, as classified above, thus increased yearly from 1871 to 1874, when a decline of about $70,000,000 followed, which subsequent advances have not yet overcome. Of the several classes, only that of animals and animal matter increased its aggregate in 1875, from $99,697,669 to $104,314,988. The cotton crop of 1874 was not so large as its predecessor, causing a reduction of nearly $20,000,000 in the exports of the fiscal year 1875. The principal reduction, however, was in wheat and flour, amounting to nearly $50,000,000, arising from diminution both of price and quantity; an instance in which large exports fail to follow large crops, showing our dependence upon European crop failures for prosperity.

In the past two years the exports of breadstuffs have been heavy, but not equal to those of 1874. The wheat exports of recent years, counting the wheat in flour, have been as follows:

Year.	Bushels.	Value.	Price per bushel.
1871	52,574,111	$69,236,608	$1 31
1872	38,995,755	56,870,744	1 45
1873	52,014,715	70,833,918	1 36
1874	91,510,398	130,679,553	1 42
1875	72,912,817	83,320,333	1 14
1876	74,750,682	92,816,369	1 24
1877	57,149,949	68,920,364	1 20
Total	439,908,427	572,677,889	1 30
Average	62,844,061	81,811,127	1 30

The fluctuation and uncertainty of quantities and prices of exported wheat are exhibited strikingly by these figures. The extraordinary exportation of 1874 commanded the highest rate per bushel ($1.42), with the single exception of that of 1872, when less than half the quantity only realized three cents more per bushel. It is possible that a small crop, with a small foreign demand, may realize only a low price, as in 1877, when the

price was lowest (with one exception) in a period of seven years, and the crop was less than an average one, and the export about six million bushels less than the average exportation for that period.

The upland cotton export has increased in quantity, since 1874, and diminished in aggregate value as follows:

Year.	Pounds.	Value.
1874	1,352,175,779	$209,109,456
1875	1,255,975,782	189,099,859
1876	1,488,760,543	191,717,459
1877	1,441,974,406	170,033,996

Diagram 11 gives a comparison of exports of animal products and cotton, showing that for four years past the former exceeds the latter by nearly one-fourth.

Salted beef and pork, including bacon and hams, increased over 150,000,000 pounds in quantity, and over 10,000,000 in value. Lard increased 66,335,394 pounds in quantity, and $3,133,180 in value. The exports of butter quadrupled in quantity and value, and those of cheese increased 10 per cent. Tallow increased nearly 20,000,000 pounds in quantity, and $1,149,338 in value.

For the first time in the annual report of Commerce and Navigation, a separate enumeration of fresh beef has been made.

The following table is furnished by Dr. Young, Chief of Bureau of Statistics of the Treasury:

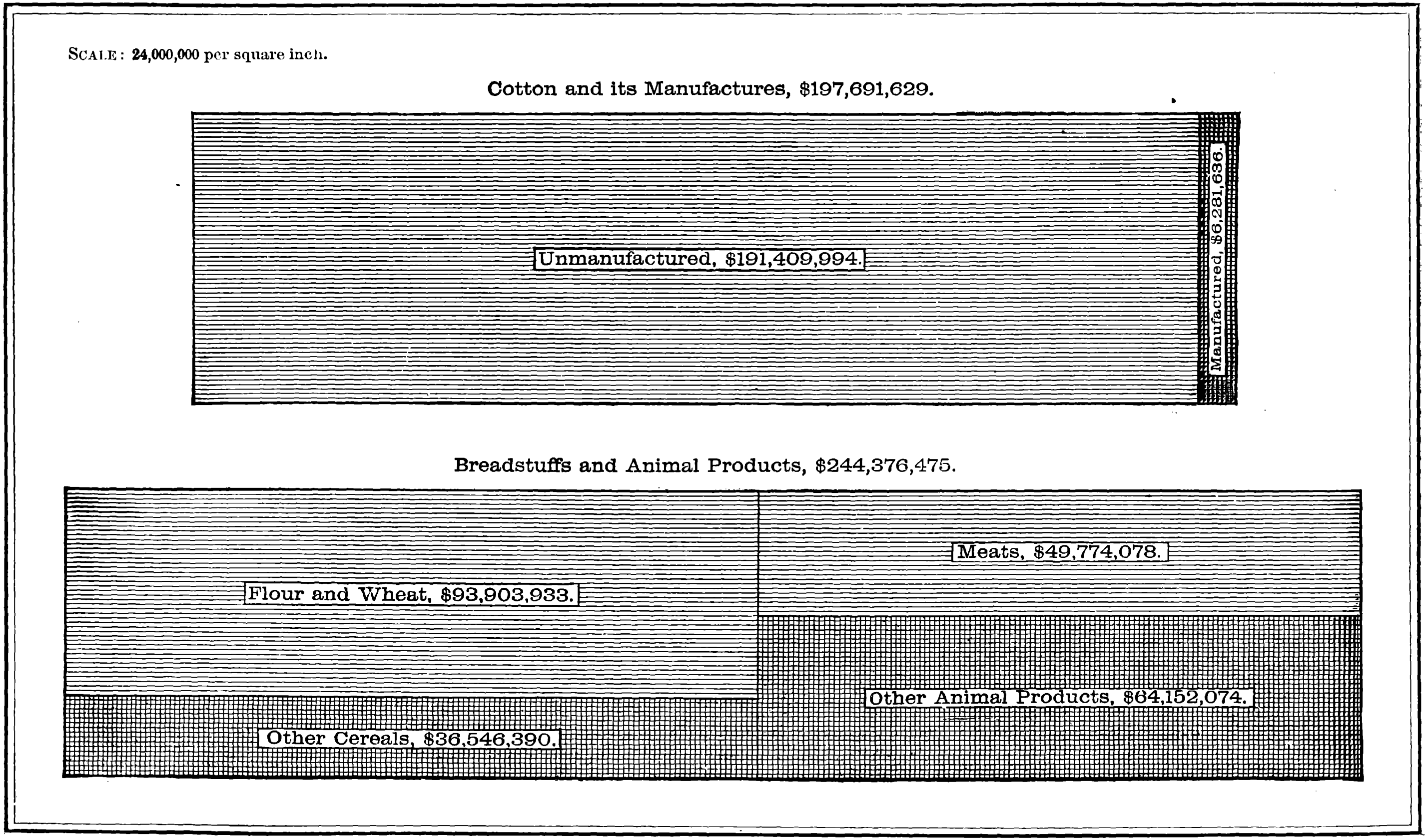
Exports of fresh beef by countries.

Month.	To England.		To Scotland.		Total exports.	
	Pounds.	Dollars.	Pounds.	Dollars.	Pounds.	Dollars.
1875.						
October	36,000	2,800			36,000	2,800
November	36,000	2,800			36,000	2,800
December	134,000	10,700			134,000	10,700
1876.						
January	162,000	12,700			162,000	12,700
February	292,000	24,000			292,000	24,000
March	302,000	24,300			302,000	24,300
April	1,256,000	106,400			1,256,000	106,400
May	912,000	69,400	100,000	8,000	1,012,000	77,400
June	940,000	72,000	200,000	16,000	1,140,000	88,000
July	645,200	44,500	525,000	56,750	1,170,200	101,250
August	1,037,000	101,811	328,000	33,000	1,365,000	134,811
September	1,838,550	154,275	613,000	63,730	2,451,550	218,005
October	2,202,685	185,088	517,000	53,950	2,719,685	239,038
November	3,598,980	331,402	595,000	60,000	4,193,980	391,402
December	3,364,480	286,055	410,000	39,850	3,774,480	325,905
1877.						
January	2,312,450	226,430	260,000	29,000	2,572,450	255,430
February	4,410,610	371,557	543,000	49,900	4,953,610	421,457
March	5,099,055	435,585	1,608,800	154,500	6,707,855	590,085
April	6,921,750	645,513	1,490,750	175,484	8,412,500	820,997
May	5,748,700	563,505	1,517,500	133,400	7,266,200	696,905
June	2,727,480	269,058	896,000	88,180	3,623,480	357,238
July	2,644,369	267,015	475,000	48,200	3,119,369	315,215
August	1,392,041	203,711	528,400	52,700	1,920,441	186,411
September	2,643,939	271,786	509,400	50,467	3,153,339	322,253
*October	3,117,723	288,946	530,000	53,988	3,694,373	347,769
*November	1,489,000	133,425	500,000	52,595	2,081,400	193,412

* In October, 1877, 46,650 pounds, worth $4,835, and in November, 1877, 92,400 pounds, worth $7,392 were shipped to France.

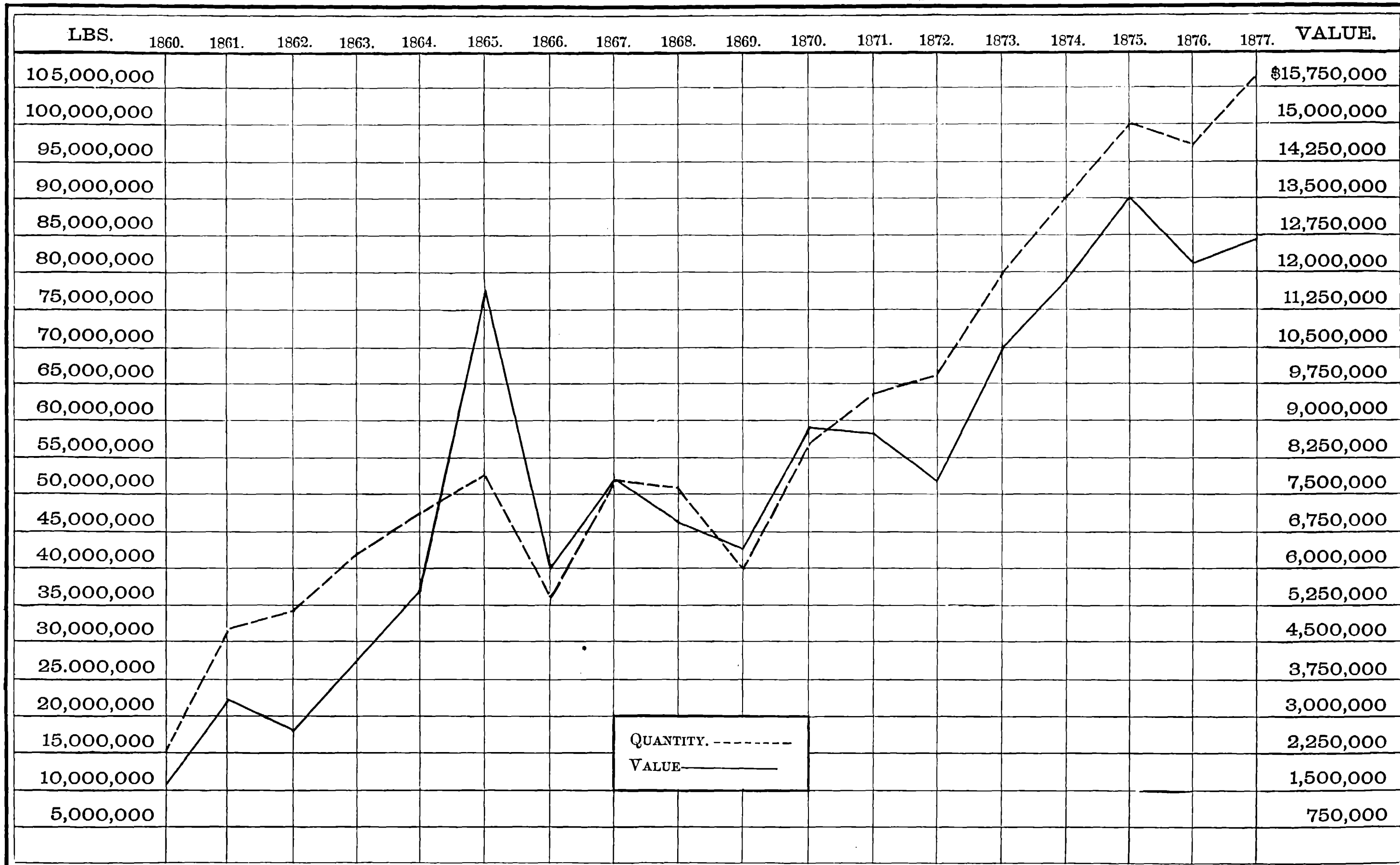
The exportation of cheese is an enterprise of recent growth, which has become a matter of national importance. Diagram 12 represents its fluctuations, the rapidity of its increase, and its present magnitude.

DIAGRAM XI.



Bread and **Meat** *vs.* Cotton.---(Average of Exports of four years, 1874--'77.)

DIAGRAM XII.



Quantity and Value of Cheese Exportation.

M. JOYCE, WASHINGTON.

DISTRIBUTION OF OUR AGRICULTURAL PRODUCTS.

ANIMALS AND ANIMAL MATTER.—The distribution of farm-animals is shown by the following table:

Animals.		United Kingdom.	British North America.	West Indies.	Mexico.	Central and South America.	Netherlands.	Japan.	Total for these countries.	Total export.
Cattle	number	5, 091	12, 640	29, 134	2, 809	3	281	42	50, 000	50, 000
	value	$546, 829	$389, 389	$587, 851	$27, 953	$500	$30, 500	$9, 858	$1, 592, 880	$1, 593, 080
Hogs	number	....	64, 443	262	348	50	....	4	65, 107	65, 107
	value	....	$695, 126	$1, 249	$1, 998	$657	....	$150	$699, 180	$699, 180
Horses	number	151	484	528	603	204	33	22	2, 025	2, 042
	value	$42, 455	$80, 708	$88, 308	$13, 764	$41, 839	$5, 000	$16, 600	$288, 674	$301, 134
Mules	number	37	25	2, 817	134	428	....	....	3, 441	3, 441
	value	$5, 550	$2, 510	$411, 845	$2, 929	$55, 600	....	....	$478, 434	$478, 434
Sheep	number	2, 767	10, 512	2, 305	161, 549	1, 288	....	531	178, 952	179, 017
	value	$22, 878	$21, 169	$22, 148	$144, 908	$8, 637	....	$10, 920	$230, 660	$234, 480
All others and fowls, value		$274	$1, 684	$3, 649	$9, 086	$3, 274	....	$15	$17, 982	$18, 895
Total value		$617, 986	$1, 190, 586	$1, 115, 150	$200, 638	$110, 407	$35, 500	$37, 543	$3, 307, 460	$3, 325, 203

Hog products, embracing hams and bacon, lard and pork, and lard-oil, amount to nearly 60 per cent. of our exports of animal matter. The following table shows the amounts taken by the leading export countries:

Products.		United Kingdom.	France.	Germany	Belgium and Netherland.	British America.
Hams and bacon	pounds	353, 210, 998	23, 167, 236	23, 715, 093	35, 288, 747	3, 632, 464
	value	$38, 866, 186	$2, 041, 520	$2, 286, 914	$3, 721, 119	$439, 655
Lard	pounds	74, 293, 602	23, 788, 669	58, 038, 751	29, 479, 437	6, 116, 553
	value	$8, 179, 438	$2, 462, 330	$6, 108, 520	$3, 313, 278	$740, 751
Pork	pounds	22, 640, 537	179, 500	1, 251, 166	232, 300	17, 990, 741
	value	$2, 165, 286	$14, 760	$117, 870	$20, 220	$1, 546, 131
Lard-oil	gallons	193, 813	26, 677	5, 000	1, 190	35, 622
	value	$148, 535	$22, 651	$4, 650	$1, 112	$27, 638
Total value		$49, 359, 453	$4, 541, 261	$8, 517, 954	$7, 055, 729	$2, 754, 175

Products.		West Indies.	Mexico, Central and South America.	China, Japan, and East Indies.	Total to these countries.	Total export.
Hams and bacon	pounds	13, 443, 531	696, 153	121, 609	449, 275, 831	460, 057, 146
	value	$1, 427, 141	$90, 149	$19, 119	$48, 891, 803	$49, 512, 412
Lard	pounds	28, 008, 762	13, 836, 903	71, 634	233, 904, 311	234, 741, 233
	value	$2, 955, 462	$1, 671, 735	$8, 854	$25, 440, 368	$25, 562, 665
Pork	pounds	22, 866, 251	3, 786, 263	131, 100	69, 077, 857	69, 671, 894
	value	$2, 037, 585	$331, 605	$10, 517	$6, 243, 474	$6, 296, 414
Lard-oil	gallons	16, 497	59, 140	....	337, 939	347, 305
	value	$16, 076	$53, 903	....	$274, 565	$281, 551
Total value		$6, 436, 264	$2, 147, 392	$38, 490	$80, 850, 210	$81, 653, 042

Cattle products, including candles, glue, hides, leather and its manufactures, neat's-foot oil, beef, butter, cheese, condensed milk, and tallow,

embrace over 31 per cent. in value of the exports of animal matter. Their distribution to the leading export countries is illustrated by the following table:

Products.		United Kingdom.	France.	Germany.	Belgium and Netherlands.	British America.
Fresh beef	pounds	49,210,990	....	....	....	....
	value	$4,552,523	....	....	....	....
Salt beef	pounds	25,622,576	226,227	2,185,990	1,040,962	2,114,903
	value	$1,981,331	$16,312	$165,065	$77,548	$140,516
Butter	pounds	15,032,877	12,250	1,237,978	32,082	1,698,159
	value	$3,121,865	$1,466	$215,055	$6,102	$327,340
Cheese	pounds	104,941,072	....	30,179	11,256	1,237,412
	value	$12,403,284	....	$3,552	$1,500	$128,948
Condensed milk	value	$31,864	$20	$264	....	$3,771
Tallow	pounds	62,299,360	13,812,610	3,676,567	5,328,806	1,477,041
	value	$5,342,294	$1,234,260	$302,348	$461,652	$117,863
Glue	pounds	20,787	....	625	10,824	24,472
	value	$3,291	....	$170	$1,793	$4,996
Hides	value	$1,441,771	$335,900	$145,674	$56,389	$459,996
Neat's-foot oil	gallons	19,692	....	....	20	45
	value	$19,468	....	....	$25	$45
Candles	pounds	27,085	....	....	....	81,978
	value	$4,875	....	....	....	$10,499
Leather	pounds	15,903,559	64,909	6,120,639	2,034,048	300,126
	value	$3,620,553	$18,140	$1,515,938	$624,720	$93,545
Morocco	value	$1,213,266	$1,375	$11,138	$29,580	$6,802
Manufactures of leather	value	$115,148	$3,445	$127,674	$20,591	$170,662
Total value to each country		$33,851,533	$1,610,858	$2,486,878	$1,279,921	$1,464,983

Products.		West Indies.	Mexico, Central and South America.	China and Japan.	Total for these countries.	Total export.
Fresh beef	pounds	....	....	....	49,210,990	49,210,990
	value	....	....	....	$4,552,523	$4,552,523
Salt beef	pounds	5,096,619	1,718,110	92,589	38,097,876	39,155,153
	value	$378,919	$133,474	$4,075	$2,933,240	$2,950,952
Butter	pounds	2,862,754	387,444	80,212	21,343,756	21,527,242
	value	$580,515	$103,505	$25,546	$4,391,434	$4,424,616
Cheese	pounds	750,177	246,343	83,739	107,330,178	107,609,480
	value	$107,091	$33,243	$13,869	$12,691,487	$12,729,615
Condensed milk	value	$16,042	$7,121	$25,180	$84,262	$123,801
Tallow	pounds	549,508	2,447,744	....	88,370,554	91,472,803
	value	$47,791	$226,886	....	$7,733,094	$7,883,616
Glue	pounds	20,433	4,269	....	81,410	157,246
	value	$5,055	$700	....	$16,005	$30,679
Hides	value	$2,449	$866	$11,588	$2,450,232	$3,113,883
Neat's-foot oil	gallons	100	30	15	19,902	19,932
	value	$106	$30	$16	$19,690	$19,970
Candles	pounds	892,499	584,194	3,040	1,488,796	1,616,163
	value	$125,155	$89,249	$3[illegible]6	$230,144	$234,408
Leather	pounds	57,390	39,055	353,551	24,873,277	25,122,936
	value	$15,277	$11,398	$80,849	$5,980,410	$6,016,373
Morocco	value	$5,526	$3,460	....	$1,271,147	$1,280,225
Manufactures of leather	value	$152,670	$190,365	$13,595	$1,308,304	$1,384,857
Total value to each country		$1,436,596	$800,297	$195,054	$40,617,935	$44,745,518

Of sheep products we exported 349,368 pounds of fresh mutton, valued at $36,480, all of which went to Great Britain. This is an adjunct to the great fresh-beef export-trade which has so suddenly risen to importance. It has been customary to stow mutton carcasses in the spaces of the refrigerating-rooms of steamers unoccupied by beef carcasses.

BREADSTUFFS, &c.—The distribution of our breadstuffs to the leading export countries was as follows:

Products.		United Kingdom.	France.	Germany.	Belgium and Netherlands.	British North America.
Barley	bushels	555,068	595	50,429	....	447,377
	value	$343,353	$578	$27,281	....	$167,380
Bread, &c	pounds	5,460	125	410	....	218,889
	value	$444	$8	$49	....	$14,781
Corn	bushels	55,466,435	1,363,281	2,136,388	464,920	9,038,881
	value	$33,111,858	$791,919	$1,274,638	$274,826	$4,676,466
Corn meal	barrels	9,492	....	401	12	271,820
	value	$32,079	....	$1,204	$56	$908,007
Oats	bushels	442,506	753,201	....	....	1,675,986
	value	$188,515	$321,787	....	....	$600,491
Rye	bushels	35,380	....	1,022,969	709,216	118,029
	value	$31,733	....	$870,524	$605,303	$75,293
Rye flour	barrels	....	....	6	....	1,221
	value	....	....	$30	....	$6,024
Wheat	bushels	31,202,296	874,642	990,067	1,830,641	4,248,434
	value	$36,579,834	$918,100	$1,010,682	$2,173,372	$4,864,534
Flour	barrels	918,283	140	10,874	13,652	640,801
	value	$5,167,634	$782	$67,900	$69,543	$4,076,989
Other grain, value		$309,281	$4,219	$84	$46,714	$34,637
Other preparations of breadstuffs, value		$327,939	$541	$11,008	$15,916	$30,646
Rice	pounds	559,112	227,689	2,364	....	64,211
	value	$37,306	$12,187	$203	....	$3,237
Total values		$76,129,976	$2,050,121	$3,263,603	$3,185,730	$15,566,485

Products.		West Indies.	Mexico, Central and South America.	China and Japan and East Indies.	Total to these countries.	Total export.
Barley	bushels	....	113,214	86	1,166,769	1,186,129
	value	....	$56,913	$54	$695,559	$708,541
Bread, &c	pounds	7,598,423	2,545,644	31,495	10,395,446	11,977,820
	value	$390,493	$144,760	$2,583	$553,118	$631,592
Corn	bushels	597,855	241,522	....	69,309,820	70,860,983
	value	$393,426	$177,860	....	$40,700,993	$41,621,245
Corn meal	barrels	154,082	9,470	....	445,277	447,907
	value	$529,624	$31,843	....	$1,502,813	$1,511,152
Oats	bushels	183,915	5,333	5,475	3,044,448	3,071,403
	value	$99,027	$3,021	$3,416	$1,225,257	$1,229,774
Rye	bushels	7,722	....	....	1,893,316	2,189,322
	value	$4,800	....	....	$1,587,653	$1,822,766
Rye flour	barrels	6,400	362	....	7,989	7,989
	value	$33,717	$1,862	....	$41,633	$41,633
Wheat	bushels	37,296	38,266	8,706	39,230,348	40,431,624
	value	$61,937	$36,624	$8,000	$45,653,083	$47,256,417
Flour	barrels	744,005	761,840	170,713	3,260,208	3,343,665
	value	$5,112,248	$5,522,440	$940,507	$20,957,123	$21,663,947
Other grain, value		$434,897	$28,946	$10,532	$869,320	$904,388
Other preparations of breadstuffs, value		$119,294	$48,344	$8,619	$562,307	$650,206
Rice	pounds	66,449	165,058	40,000	1,124,783	1,427,598
	value	$4,016	$10,398	$1,760	$69,107	$85,349
Total values		$7,184,479	$6,076,611	$975,471	$115,542,779	$118,126,960

Great Britain and her colonies still continue to take most of our surplus; during the past year about seven-eighths of all. In some years it has been 97 per cent. of wheat products.

The following tables show the quantities and values of our annual exports of flour, meal, and grain for the last fourteen fiscal years, compiled from the annual reports of the Treasury Bureau of Statistics, with calculations of average values, and other deductions:

Fiscal years.	FLOUR.			WHEAT.			FLOUR AND WHEAT CONSOLIDATED.			PER CENT. OF FLOUR.	
	Barrels.	Value.	Average value per barrel.	Bushels.	Value.	Average value per bushel.	Bushels.	Value.	Average value per bushel.	Quantity.	Value.
1863-'64	3,557,347	$25,588,249	$7 19.3	23,681,712	$31,432,133	$1 32.7	41,468,447	$57,020,382	$1 37.5	42.89	44.87
1864-'65	2,604,542	27,222,031	10 45.2	9,397,152	19,397,197	1 95.2	22,959,862	46,619,228	2 03.0	56.72	58.39
1865-'66	2,183,050	18,396,686	8 42.7	5,579,103	7,842,749	1 40.6	16,494,353	26,239,435	1 59.1	66.17	70.11
1866-'67	1,300,106	12,803,775	9 84.7	6,146,411	7,822,555	1 27.2	12,646,941	20,626,330	1 62.1	51.40	62.07
1867-'68	2,076,423	20,887,798	10 05.9	15,940,899	30,247,632	1 89.7	26,323,014	51,135,430	1 94.2	39.44	40.85
1868-'69	2,431,873	18,813,865	7 73.2	17,557,836	24,383,259	1 38.8	29,717,201	43,297,124	1 45.7	40.92	43.45
1869-'70	3,463,333	21,169,593	6 11.3	36,584,115	47,171,229	1 28.9	53,900,780	68,340,822	1 26.8	32.13	30.98
1870-'71	3,653,841	24,093,184	6 59.4	34,304,906	45,143,424	1 31.6	52,574,111	69,236,608	1 31.7	34.75	34.79
1871-'72	2,514,535	17,955,684	7 14.1	26,423,080	38,915,060	1 47.2	38,995,755	56,870,744	1 45.8	32.24	31.57
1872-'73	2,562,086	19,381,664	7 56.5	39,204,285	51,452,254	1 31.2	52,014,715	70,833,918	1 36.1	24.62	27.36
1873-'74	4,094,094	29,258,094	7 14.6	71,039,928	101,421,459	1 42.8	91,510,398	130,679,553	1 42.8	22.37	22.39
1874-'75	3,973,128	23,712,440	5 96.8	53,047,177	59,607,863	1 12.4	72,912,817	83,320,333	1 14.3	27.24	28.45
1875-'76	3,935,512	24,433,470	6 20.8	55,073,122	68,382,899	1 24.1	74,750,682	92,816,369	1 24.2	26.32	26.32
1876-'77	3,343,665	21,663,947	6 47.0	40,431,624	47,256,417	1 16.8	57,149,949	68,920,364	1 20.6	29.25	31.43

Fiscal years.	CORN MEAL.			CORN.			CORN AND CORN MEAL CONSOLIDATED.			PROPORTION OF MEAL.	
	Barrels.	Value.	Value per barrel.	Bushels.	Value.	Value per bushel.	Bushels.	Value.	Value per bushel.	Quantity.	Value.
1863-'64	262,357	$1,349,765	$5 14.5	4,096,624	$3,353,280	$0 81.8	5,146,192	$4,703,045	$0 91.4	20.39	28.69
1864-'65	199,419	1,489,886	7 47.1	2,812,726	3,679,133	1 30.8	3,610,402	5,169,019	1 43.1	22.09	28.63
1865-'66	237,275	1,129,484	4 76.0	13,516,651	11,070,395	81.9	14,465,751	12,199,879	84.2	6.55	9.26
1866-'67	284,287	1,555,585	5 47.2	14,889,823	14,871,092	99.9	16,026,947	16,426,677	1 02.5	7.09	9.47
1867-'68	336,508	2,068,430	6 14.7	11,147,490	13,094,036	1 17.4	12,493,522	15,162,466	1 21.4	10.77	13.64
1868-'69	309,867	1,656,273	5 34.5	7,047,197	6,820,719	96.8	8,286,665	8,476,992	1 02.3	14.96	19.54
1869-'70	187,093	935,676	5 01.1	1,392,115	1,287,575	92.5	2,140,487	2,223,251	1 03.9	34.96	42.09
1870-'71	212,641	951,830	4 47.6	9,826,309	7,458,997	75.8	10,676,873	8,410,827	78.8	7.97	11.32
1871-'72	308,840	1,214,999	3 93.4	34,491,650	23,984,365	69.5	35,727,010	25,199,364	70.5	3.46	4.82
1872-'73	403,111	1,474,827	3 65.8	38,541,930	23,794,694	61.7	40,154,274	25,269,521	62.9	4.01	5.84
1873-'74	387,807	1,529,399	3 94.4	34,434,606	24,769,951	71.9	35,985,834	26,299,350	73.1	4.31	5.81
1874-'75	291,654	1,290,533	4 42.5	28,858,420	24,456,937	84.7	30,025,036	25,747,470	85.7	3.89	5.01
1875-'76	354,240	1,305,027	3 68.4	49,493,572	33,265,280	67.2	50,910,532	34,570,307	67.9	2.78	3.77
1876-'77	447,907	1,511,152	3 37.4	70,860,983	41,621,245	58.7	72,652,611	43,132,397	59.3	2.46	3.50

Fiscal years.	RYE FLOUR.			RYE.			RYE AND FLOUR CONSOLIDATED.			PROPORTION OF FLOUR.	
	Barrels.	Value.	Value per barrel.	Bushels.	Value.	Value per bushel.	Bushels.	Value.	Value per bushel.	Quantity.	Value.
1863–'64	6, 999	$37, 991	$5 42. 8	154, 960	$150, 109	$0 96. 8	189, 955	$188, 100	$0 99. 0	18. 42	20. 19
1864–'65	3, 935	32, 438	8 24. 3	132, 459	133, 430	1 00. 7	152, 134	165, 868	1 09. 0	12. 93	19. 56
1865–'66	13, 304	68, 144	5 12. 2	417, 127	381, 498	91. 4	483, 647	449, 642	92. 9	13. 75	15. 15
1866–'67	14, 603	112, 414	7 69. 7	147, 353	133, 514	90. 6	220, 368	245, 928	1 11. 6	33. 13	45. 72
1867–'68	10, 592	90, 958	8 58. 7	501, 349	836, 838	1 66. 9	554, 309	937, 796	1 69. 2	9. 55	9. 69
1868–'69	7, 228	52, 249	7 22. 8	49, 501	55, 957	1 11. 0	85, 641	108, 206	1 26. 3	42. 19	48. 28
1869–'70	6, 974	38, 458	5 51. 4	157, 606	178, 275	1 13. 1	192, 476	216, 733	1 12. 6	18. 12	17. 74
1870–'71	6, 250	34, 135	5 46. 1	49, 674	44, 678	89. 9	80, 924	78, 813	97. 4	38. 61	43. 31
1871–'72	6, 287	34, 401	5 47. 1	794, 967	703, 929	88. 5	826, 402	738, 330	89. 3	3. 80	4. 66
1872–'73	8, 288	46, 129	5 56. 5	562, 021	469, 547	83. 5	603, 461	515, 676	85. 4	6. 87	8. 94
1873–'74	59, 820	388, 313	6 49. 1	1, 564, 484	1, 568, 362	1 00. 2	1, 863, 584	1, 956, 675	1 04. 0	16. 05	19. 84
1874–'75	9, 993	54, 964	5 50. 0	207, 100	204, 590	98. 8	257, 065	259, 554	1 00. 9	19. 43	21. 17
1875–'76	7, 553	39, 054	5 17. 0	543, 841	480, 083	88. 3	581, 606	519, 137	89. 3	6. 49	7. 52
1876–'77	7, 989	41, 633	5 48. 6	2, 189, 322	1, 822, 766	83. 2	2, 227, 267	1, 864, 399	83. 7	1. 70	2. 23

Fiscal years.	OATS.			BARLEY.			TOTAL CEREALS.			Average of the monthly means of the value of gold.
	Bushels.	Value.	Value per bushel.	Bushels.	Value.	Value per bushel.	Bushels.	Value.	Value per bushel.	
1863–'64	305, 755	$268, 345	$0 87. 7	66, 482	$64, 423	$0 96. 9	47, 176, 761	$62, 244, 295	$1 32. 0	1. 58$\frac{1}{3}$
1864–'65	318, 117	256, 949	80. 7	44, 248	57, 651	1 30. 3	27, 084, 763	52, 268, 715	1 92. 9	2. 02$\frac{1}{8}$
1865–'66	1, 245, 658	703, 711	56. 5	....	....	....	32, 689, 409	39, 592, 667	1 21. 0	1. 41$\frac{1}{8}$
1866–'67	825, 895	465, 974	56. 4	....	....	....	29, 720, 151	37, 764, 909	1 27. 0	1. 41$\frac{1}{8}$
1867–'68	122, 554	105, 167	85. 8	9, 810	10, 981	1 11. 9	39, 503, 209	67, 351, 840	1 70. 5	1. 40$\frac{3}{8}$
1868–'69	481, 871	306, 678	63. 6	59, 077	46, 290	78. 3	38, 630, 455	52, 235, 290	1 35. 2	1. 37$\frac{3}{4}$
1869–'70	121, 517	76, 528	62. 9	255, 490	140, 512	54. 9	56, 610, 750	70, 997, 846	1 25. 4	1. 23$\frac{1}{12}$
1870–'71	147, 572	83, 080	56. 2	340, 093	200, 625	58. 9	63, 819, 573	78, 009, 953	1 22. 2	1. 13$\frac{1}{4}$
1871–'72	262, 975	135, 129	51. 4	86, 891	63, 407	72. 9	75, 899, 033	83, 006, 974	1 00. 3	1. 11$\frac{2}{3}$
1872–'73	714, 072	290, 575	40. 7	482, 410	323, 187	66. 9	93, 968, 932	97, 232, 877	1 03. 7	1. 12$\frac{5}{6}$
1873–'74	812, 873	383, 762	47. 2	320, 399	210, 738	65. 8	130, 493, 088	159, 530, 078	1 22. 2	1. 12$\frac{1}{2}$
1874–'75	504, 770	290, 537	57. 5	91, 118	61, 408	67. 4	103, 790, 806	109, 679, 302	1 05. 5	1. 12$\frac{5}{8}$
1875–'76	1, 466, 228	588, 583	40. 1	317, 781	210, 584	66. 3	128, 026, 829	128, 704, 980	1 00. 5	1. 14$\frac{5}{8}$
1876–'77	3, 071, 403	1, 229, 774	40. 0	1, 186, 129	708, 541	59. 8	136, 287, 359	115, 855, 475	85. 0	1. 07$\frac{15}{32}$

Proportions of different grains in each annual export of the last fourteen fiscal years.

Fiscal years.	Wheat and flour.		Corn and corn-meal.		Rye and rye-flour.		Oats.		Barley.	
	Quantity.	Value.	Quantity.	Value.	Quantity.	Value.	Quantity.	Value.	Quantity.	Value.
1863–'64	87.90	91.60	10.91	6.34	0.40	0.26	0.65	0.37	0.14	0.13
1864–'65	84.77	89.10	13.33	9.79	.48	.31	1.18	.48	.16	.21
1865–'66	50.45	66.27	44.25	30.81	1.48	1.10	3.81	1.77	....	....
1866–'67	42.55	54.61	53.92	43.49	.74	.65	2.77	1.23	....	....
1867–'68	66.63	75.92	31.45	22.51	1.37	1.39	.31	.16	.02	.02
1868–'69	76.92	82.88	21.45	16.23	.22	.20	1.25	.60	.15	.12
1869–'70	95.21	96.25	3.78	3.00	.36	.30	.21	.11	.45	.24
1870–'71	82.38	88.75	16.73	10.78	.13	.11	.23	.10	.53	.30
1871–'72	51.37	68.50	47.07	30.35	1.09	.75	.24	.16	.11	.08
1872–'73	55.35	72.84	42.73	25.98	.65	.53	.76	.30	.51	.35
1873–'74	70.12	81.90	27.49	16.48	1.42	1.22	.62	.24	.24	.16
1874–'75	70.25	75.96	28.90	23.47	.19	.23	.38	.26	.09	.05
1875–'76	58.31	71.93	39.76	26.86	.45	.42	1.14	.45	.20	.16
1876–'77	41.92	59.48	53.31	37.24	1.65	1.61	2.25	1.06	.87	.61

Taking corn and meal together the exportation of 1877 was seven times as much as the average for the fifty-two years which comprise nearly all our foreign shipments of corn, and nearly one-seventh of the whole volume.

	Bushels.
Total exports for fifty-two years	526,883,953
Average export per annum	10,132,383
Exports of 1877	72,652,611

The price of the last export was less than the average price for fifty-two years: 59.3 cents against 73.5 cents.

COTTON AND ITS MANUFACTURES.—The following table shows the distribution of cotton and its manufactures to the leading export countries;

Products.		United Kingdom.	France.	Germany.	Belgium and Netherlands.	British North America.
Sea island	bales	8,972	891	....	....	....
	pounds	3,107,016	287,708	....	....	....
	value	$975,663	$108,846	....	....	....
Other	bales	2,195,024	447,096	165,781	62,162	11,614
	pounds	1,017,258,420	218,801 053	77,605,283	29,154,474	5,508,304
	value	$120,154,746	$25,341,993	$9,061,899	$3,465,660	$797,228
Colored goods	yards	3,297,279	....	390,553	3,330	1,201,501
	value	$259,914	....	$30,841	$356	$100,713
Uncolored goods	yards	18,017,950	....	2,617,014	21,614	3,539,359
	value	$1,624,231	....	$227,103	$3,406	$426,688
Other manufactures	value	$125,011	$443	$4,510	$8,843	$2,753,897
Total values		$123,139,565	$25 451,282	$9,324,353	$3,478,265	$4,078,526
Raw material	bales	2,203,996	447,987	165,781	62,162	11,614
	pounds	1,020,365,436	219,088,861	77,605,283	29,154,474	5,508,304
	value	$121,130,409	$25,450,839	$9,061,899	$3,465,660	$797,228
Manufactures	value	$2,008,156	$443	$262,454	$12,605	$3,281,298

Products.		West Indies.	Mexico, Central and South America.	China, Japan, and East Indies.	Total to these countries.	Total export.
Sea island	bales	....	....	....	9, 863	9, 863
	pounds	....	....	....	3, 394, 724	3, 394, 724
	value	....	....	....	$1, 084, 509	$1, 084, 509
Other	bales	....	*8, 835	....	2, 890, 512	3, 110, 609
	pounds	....	3, 969, 812	....	1, 352, 297, 346	1, 441, 974, 406
	value	....	$462, 902	....	$159, 284, 428	$170, 023, 999
Colored goods	yards	5, 408, 954	15, 436, 327	203, 000	26, 940, 944	29, 601, 304
	value	$464, 924	$1, 361, 615	$17, 128	$2, 235, 491	2, 484, 131
Uncolored goods	yards	2, 782, 661	21, 428, 062	15, 099, 025	63, 505, 525	76, 769, 147
	value	$265, 815	$1, 722, 975	$1, 208, 712	$5, 478, 930	$6, 437, 223
Other manufactures	value	$74, 334	$97, 716	$13, 604	$3, 078, 458	$3, 213, 386
Total values		$805, 073	$3, 645, 208	$1, 239, 444	$171, 161, 816	$183, 253, 248
Raw material	bales	....	8, 835	....	2, 900, 375	3, 120, 472
	pounds	....	3, 969, 812	....	1, 355, 692, 170	1, 445, 369, 130
	value	....	$462, 902	....	$160, 368, 937	$171, 118, 508
Manufactures	value	$805, 073	$3, 182, 306	$1, 239, 444	$10, 791, 799	$12, 134, 740

* All to Mexico.

WOOD AND ITS PRODUCTS.—This class of exports aggregated $23,422,966, of which the United Kingdom received $9,220,006; the West Indies, $4,896,841; British America, $2,914,877; South America, $1,855,338; Germany, $1,214,020; Spain and Portugal, $1,112,656; Belgium and Netherlands, $789,534; France, $568,846; Italy, $260,832; China, Japan, and East Indies, $167,935; Sweden, Norway, and Denmark, $88,272.

MISCELLANEOUS.—The following table shows the distribution of our leading miscellaneous exports:

Products.		United Kingdom.	France.	Germany.	Belgium and Netherlands.	British North America.
Fruits	value	$1, 296, 808	$14, 423	$567, 776	$291, 240	$409, 664
Hemp and its products	do	$492, 631	$27, 187	$52, 278	$24, 038	$79, 541
Hops	pounds	7, 575, 052	415, 023	1, 007, 735	290, 745	65, 653
	value	$1, 719, 299	$145, 274	$308, 417	$78, 519	$11, 410
Spirits	gallons	498	367, 199	745	56	14, 651
	value	$1, 384	$143, 483	$1, 413	$85	$30, 344
Oil-cake	pounds	268, 703, 276	429, 889	....	....	62, 056
	value	$4, 716, 441	$7, 000	....	....	$1, 160
Oil, cotton-seed	gallons	290, 609	17, 715	....	138, 715	2, 290
	value	$145, 783	$8, 771	....	$67, 728	$2, 290
Seed, cotton	pounds	10, 308, 814	480	....	....	....
	value	$130, 002	$60	....	....	....
Starch	pounds	984, 181	78, 400	3, 407, 582	2, 303, 586	335, 214
	value	$60, 202	$2, 821	$163, 679	$74, 151	$23, 751
Sugar, refined	pounds	26, 620, 574	....	22, 500	....	18, 600, 895
	value	$3, 154, 489	....	$2, 250	....	$1, 971, 816
Molasses	gallons	2, 078, 681	71	271, 629	....	868, 118
	value	$480, 869	$31	$93, 777	....	$270, 030
Tobacco, leaf	pounds	67, 717, 563	28, 488, 442	76, 339, 888	33, 838, 763	8, 416, 188
	value	$8, 758, 042	$2, 491, 421	$7, 037, 249	$2, 480, 682	$1, 022, 478
Tobacco manufactures	value	$1, 218, 259	$5, 629	$188, 008	$122, 129	$140, 182
Potatoes	bushels	578	3, 012	....	....	15, 588
	value	$795	$3, 460	....	....	$10, 060
Ginseng	pounds	76, 480	....	....	....	....
	value	$101, 598	....	....	....	....
Total values		$22, 276, 702	$2, 849, 560	$8, 414, 847	$3, 138, 572	$3, 972 726

Products.		West Indies.	Mexico, Central and South America.	China, Japan, and East Indies.	Total to these countries.	Total export.
Fruits	value	$72,919	$85,645	$41,360	$2,694,190	$3,163,155
Hemp and its products	do	$76,604	$73,470	....	$825,749	$907,741
Hops	pounds	14,475	27,535	4,892	9,405,110	9,587,675
	value	$2,658	$6,018	$1,302	$2,272,897	$2,306,537
Spirits	gallons	2,706	383,055	5,026	*773,886	1,659,151
	value	$977	$201,128	$16,690	$395,504	$782,327
Oil-cake	pounds	4,402,996	16,205	6,720	273,621,142	273,670,940
	value	$92,125	$360	$109	$4,817,195	$4,818,923
Oil, cotton-seed	gallons	42	420	....	†449,791	1,705,422
	value	$28	$217	....	$224,817	$842,248
Seed, cotton	pounds	....	....	....	10,309,294	10,309,294
	value	....	....	....	$130,062	$130,062
Starch	pounds	303,694	1,870,484	46,629	9,529,768	9,801,416
	value	$19,938	$78,581	$1,735	$424,858	$462,234
Sugar, refined	pounds	1,835,987	7,076,249	69,767	54,225,952	54,867,713
	value	$214,499	$779,836	$7,790	$6,130,680	$6,198,139
Molasses	gallons	105	4,978	389	3,223,971	3,428,877
	value	$33	$1,539	$558	$846,837	849,817
Tobacco, leaf	pounds	3,053,995	2,566,993	....	‡220,431,832	282,386,426
	value	$451,915	$368,907	....	$22,610,694	$28,825,521
Tobacco manufactures	value	$209,317	$270,172	$45,591	$2,199,287	$3,194,693
Potatoes	bushels	397,326	45,001	53,465	514,970	529,650
	value	$444,281	$39,186	$27,684	$525,466	$533,187
Ginseng	pounds	....	....	363,926	437,406	440,406
	value	....	....	$460,670	$562,268	$562,268
Total values		$1,585,295	$1,905,059	$603,489	$44,660,504	$53,576,912

* Over a third of our export of spirits—622,375 gallons, valued at $276,736—went to the European settlement in Africa.

†The countries named in the above table consume but a small portion of our surplus cotton-seed oil. Italy found a market for 872,949 gallons, valued at $438,028; Spain, 260,743 gallons, valued at $123,906; Gibraltar, 121,939 gallons, worth $55,497.

‡ Italy took 33,824,379 pounds of leaf tobacco, valued at $3,734,030; Spain, 15,281,482 pounds, valued at $866,650.

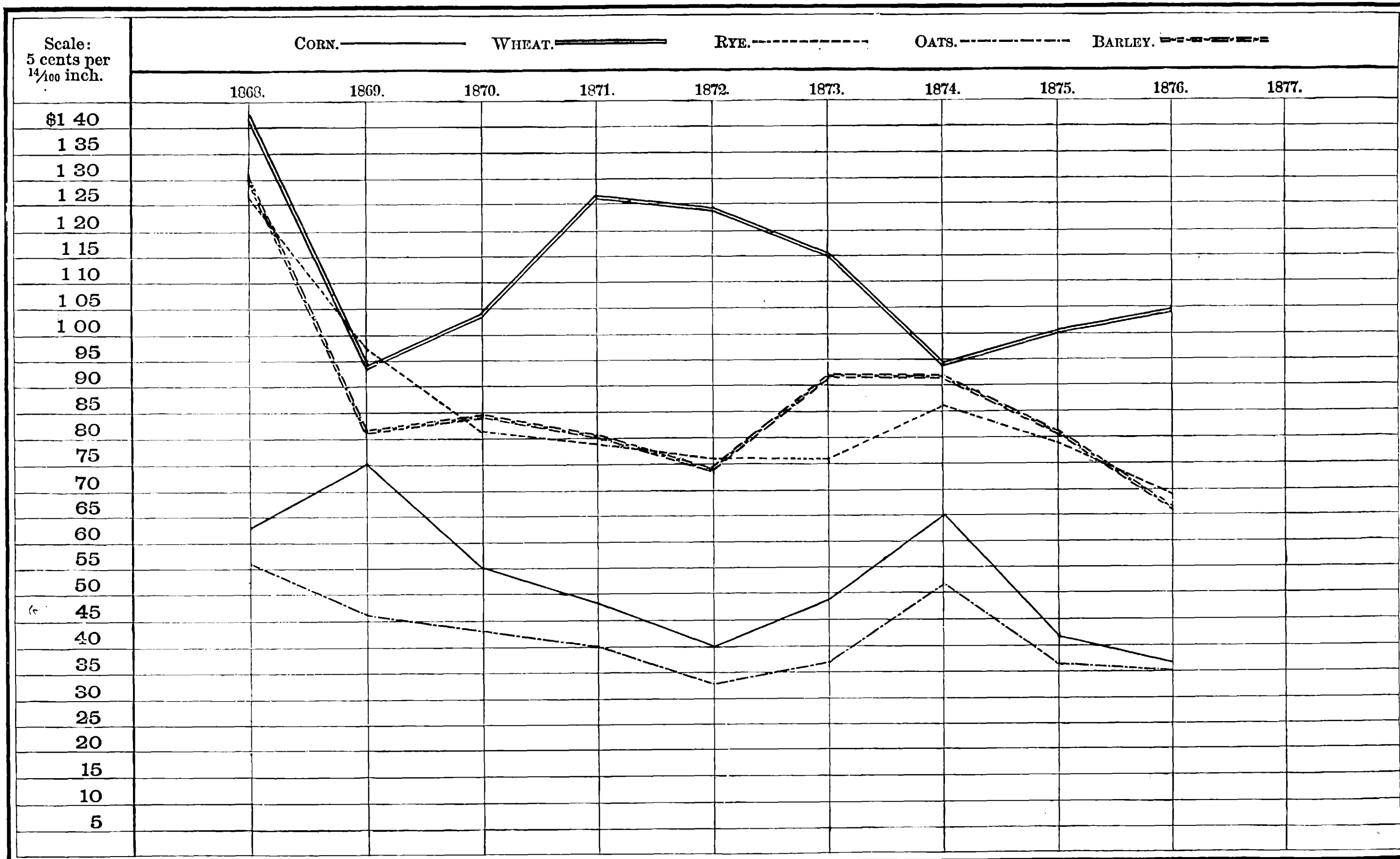
PRICES OF FARM PRODUCTS.

THE COURSE OF PRICES DURING TEN YEARS.

During the past ten years the tendency of prices has been downward, modified by the exigencies of supply and demand, the abundance or scarcity of the crop. In the case of corn, the export demand is not sufficient to affect prices materially. The high prices of wheat in 1867 have never since been obtained, yet there have been great fluctuations since, due largely to the ruling rates in Great Britain, the principal market for our surplus. The prices of oats have followed those of corn, both being used mainly for feeding animals, each convenient for supplying any scarcity of the other. Fluctuations are less in barley, and still less in buckwheat. The potato crop is less affected in price by the devastations of the beetle than in former years. The enormous crop of 1875 reduced the average price almost one-half—to 38.9.

The order of prominence in prices of cereals is well sustained amid all the fluctuations of varying supply, wheat, of course, occupying the highest position, and barley and rye following next in order. Corn and oats, large crops used mainly as feeding material, though a considerable portion of the former enters into the production of various forms of food for man, occupy a lower plane in value, corn maintaining a higher position under all the circumstances attending these crops in recent years. Diagram 4 indicates the striking parallel in the course of prices of these

DIAGRAM XIII.



M. JOYCE, WASHINGTON.

Prices of Cereals.

two crops. The average prices of wheat in home markets for the past ten years are as follows:

Years.	Wheat.	Barley.	Rye.	Corn.	Oats.
1868	$1 42.4	$1 30.1	$1 27.4	$0 62.8	$0 55.8
1869	94.1	81.6	97.1	75.3	47.6
1870	1 04.2 +	84.5 +	81.5 +	54.9	43.3 +
1871	1 25.8 +	80.6 +	79.0 +	48.2 +	40.1 +
1872	1 24.0 +	73.8 +	76.3 +	39.8 +	33.6 +
1873	1 15.0 +	91.5 +	76.2 +	48. −	37.4 +
1874	94.4 +	92.1 +	85.8 +	64.7 −	52.0 +
1875	1 00.0 +	81.1 +	76.9 +	42.0 +	36.5 +
1876	1 03.7 +	66.4 +	66.9 +	37.0 +	35.1 +
1877	....	....	....	35.8 +	....

WEIGHTS PER BUSHEL IN THE SEVERAL STATES.

In the annual report of this department for 1871 will be found a digest of the laws of the several States regulating the number of pounds per bushel of different kinds of farm products. A circular was addressed to the secretaries of the several States, requesting to be informed of any changes in the standards existing in 1871. A table below gives an abstract of these returns, showing a few changes since the publication of our previous investigation. In some cases the return stated that the State had adopted no legal standard, and that the standard established by Congress was the only one recognized. A careful inquiry fails to show that Congress has ever established a general standard, but in one or two instances has designated, for special purposes, a standard weight per bushel for a few articles. For instance, the customs-revenue officers, in fixing the amount of duties upon imported grain, are directed to allow 60 pounds per bushel for wheat, 56 for corn and rye, 48 for barley, 32 for oats, 60 for pease, and 42 for buckwheat. (See Revised Statutes, sec. 2919.) Again, the Commissioner of Internal Revenue is directed, in assessing tax upon distilled liquors, to allow 56 pounds per bushel of all sorts of grain. (See Revised Statutes, sec. 3309.)

An inquiry into the practice of the different executive departments of the government showed that the Navy Department purchased such products by weight exclusively. The Commissary-General of the Army, purchases only beans and potatoes, allowing 60 pounds per bushel for both of these articles. The Quartermaster-General, in purchasing supplies for the Army, conforms to the local customs of the market in which he buys. The supplies are issued to the Army exclusively by weight.

The Second Comptroller, in revising the accounts of quartermasters and commissaries, observes the following standards: Corn, 56 pounds per bushel; wheat, 60; rye, 56; buckwheat, 52; barley, 48; oats, 32; beans, 60; potatoes, 60; onions, 57; dried peaches, 33; dried apples, 22; salt, 50; anthracite coal, 54; bituminous coal, 76; charcoal, 22; corn on the cob, 70; turnips, 60; carrots, 60.

It is evident, then, that the general government has fixed no legal standards of weights per bushel, and that its executive departments are compelled to accept custom and usage as their only guides. The few changes indicated by the following table, compared with the abstract published in the report of 1871, show a tendency to greater uniformity. It is desirable that some definite standard be fixed. There is an increasing disposition to substitute weight for measure in ascertaining the quantity of grain in commercial transactions. It would be of immense benefit to production and trade in agricultural as well as other commodities if the metric system could be brought into general use.

Legal weight per bushel, in pounds, in 1878.

States.	Apples, dried.	Barley.	Beans, castor.	Beans, white.	Bran.	Buckwheat.	Coal.	Corn, ear.	Corn, shelled.	Corn meal.	Hair.	Lime, unslaked.	Malt, barley.	Onions.	Oats.	Peaches.	Potatoes, Irish.	Potatoes, sweet.	Pease.	Rye.	Salt.	Blue-grass seed.	Clover seed.	Flax seed.	Hemp seed.	Hungarian-grass seed.	Millet seed.	Osage-orange seed.	Sorghum seed.	Timothy seed.	Turnips.	Wheat.
Maine		48		64		48			56					52	30		60		60	50											50	60
New Hampshire				60					56	50					32		60		60	56												60
Vermont		48	60	60		46			56					52	32		60		60	56			60							45	60	60
Massachusetts																																
Rhode Island		48							56	50				50	32		60			56												
Connecticut		48		60		48			56	50				50	32		60		60	56											50	60
New York		48		*a*62		48			58								60		60	56			60	55						44		60
New Jersey	25	48	60	60		50			56					57	30	33	60	54	60	56			64	55								60
Pennsylvania						48			56						30		56			56	*b*85		62									60
Delaware*									56	*c*48																						60
Maryland	28	48	60	60		48	80	70	56	48	7		34	56	32	*d*40	60	56	62	56		14	64	56	44	48	50	33		45	56	60
Virginia	28	48		60		52	80	70	56	50	8	80	38	57	32	*d*40	60	56	60	56	50	14	60	56	44	48	50	34		45	55	60
North Carolina																																
South Carolina																																
Georgia	24	47		60	20	52	80	70	56	48	8	80		57	32	*e*38	60	55	60	56		14	60	56	44					45	55	60
Florida*																																
Alabama*																																
Mississippi																																
Louisiana																																
Texas*																																
Arkansas*																																
Tennessee*																																
West Virginia	25	48		60		52	80		56						32	33	60			56			60	56						45		60
Kentucky	24	47	45	60	20	55	76	70	55	50	8	35		57	32	39	60	55	60	56	50	14	60	56	44	50	50			45	60	60
Ohio	22	48		60		50	80	*f*70	56			70	34	50	32	33	60	50	60	56			60	56	44	50	50			45		60
Michigan	22	48	46	60		48	80	70	56	50		70		54	32	28	60	56	60	56	56	14	60	56	44	50	50	33		45	58	60
Indiana	25	48	66	60		50	*g*80	68	56	50				48		33	60			56	50	14	60		44					45		60
Illinois	24	48	46	60	20	52	80	70	56	48	8	80	38	57	32	33	60	55		56	*h*55 / 50	14	60	56	44					45	55	60
Wisconsin	28	48				50			56				48		32	28	60			56			60	56						46		60
Minnesota	28	48				42			56						32	28	60			56			60									60
Iowa	24	48	46	60	20	52	80	70	56			80		57	32	33	60	46		56	50	14	60	56	44	45	45	32	30	45		60
Missouri	24	48	46	60	20	52	80		56					57	32	33	60			56	50	14	60	56	44					45		60
Kansas	24	48	44	60	20	50	80	70	56	50	8	80	32	57	32	33	60	50		56	50	14	60	54	44	50	50			45	55	60
Nebraska	24	48	46	60	20	52	80	70	56	50	8	80	30	57	34	33	60	50	60	56	50	14	60	56	44	60	40	32	30	45	55	60
California*		50				40			52						32					54												60
Oregon																																
Nevada																																
Colorado		48		60		52	80	70	56	50		80		57	32		60			56	80	14	60		44					45		60

* The standard adopted by the United States. *a* Disregarded in practice; sales of beans being made at 60, and of corn at 56. *b* Foreign: coarse, 85; ground, 70; fine, 62. *c* Sifted, 44. *d* Unpeeled. *e* Unpeeled, 33. *f* After the 1st of January following its production, 68. *g* Mined within the State. *h* Fine, 55; coarse, 50.

In a few instances the weights established by law of agricultural products not enumerated in the table were reported. *Apples:* In Maine, 44 pounds; Vermont, 46; Michigan, Iowa, and Missouri, 48. *Beets:* In Maine, Vermont, and Connecticut, 60 pounds. *Carrots:* In Maine and Vermont, 50 pounds; Connecticut, 55. *Parsnips:* In Connecticut, 45 pounds. *Berries:* In Rhode Island, 32 pounds. In Iowa, cherries, grapes, currants, and gooseberries, 40 pounds; blackberries, strawberries, and raspberries, 32; peaches and quinces, 48; broom-corn seed, 30. In Michigan, dried plums, 28 pounds; cranberries, 40. In Michigan and Virginia, orchard-grass seed, 14 pounds; in former, red-top seed, 14; in latter, 12; pea-nuts, 22; chestnuts, 57. In Wisconsin, rape-seed, 50 pounds. In Indiana, Kansas, and Nebraska, hay, 2,000 pounds per ton. In Maryland, bran, 2,240 pounds per ton.

The following legalized measures were also reported: In Rhode Island, a cask of lime is to contain 31½ gallons. In New Hampshire, a measure for charcoal is to contain 2 bushels, and shall not be less than 20 inches in diameter, and deep enough to hold 18 gallons; milk is to be sold by wine-measure. In Pennsylvania, the standard bushel for bituminous coal and for coke is to contain 2,688 cubic inches, even measure; for charcoal, 2,571 cubic inches. In Wisconsin, "the half bushel, and the parts thereof, shall be the standard measure for charcoal; fruits and other commodities sold by heaped measure shall, in being measured by the half bushel or smaller measures, be heaped as high as may be without special effort or design." In Missouri, the standard bushel for coke and charcoal is to contain 2,680 cubic inches; apple-barrels, length, 28½ inches; chines, ¾ of an inch at ends; diameter of head, 17¼ inches; inside diameter at the center of the barrel, 20½ inches. In Kansas, "in the sale of charcoal, fruits, vegetables, and all other articles sold by the heaped measure, 1,282 cubic inches shall constitute a half bushel."

DISTRIBUTION OF FARM PRODUCTS.

The following table shows the annual receipts for seven calendar years of flour, wheat, corn, rye, oats, and barley at New York, Boston, Portland, Montreal, Philadelphia, Baltimore, and New Orleans, the seven leading outports of our foreign trade in breadstuffs:

Products.	1871.	1872.	1873.	1874.	1875.	1876.	1877.
Flour ....bbls	9, 700, 695	9, 239, 559	10, 300, 848	11, 476, 184	10, 889, 544	10, 889, 306	8, 546, 349
Wheat ....bush	43, 497, 362	28, 188, 129	52, 938, 252	63, 308, 229	54, 938, 667	43, 074, 032	46, 000, 508
Flour and wheat..do..	92, 000, 837	74, 385, 904	104, 442, 492	120, 689, 149	109, 386, 387	97, 520, 562	88, 732, 253
Corn ....do..	53, 251, 350	77, 586, 345	54, 407, 806	54, 857, 006	51, 961, 559	88, 758, 838	87, 804, 025
Oats .... do..	24, 027, 948	24, 522, 650	24, 144, 032	21, 906, 211	21, 236, 003	25, 669, 813	20, 638, 892
Rye.................do..	1, 624, 273	1, 023, 897	1, 305, 902	987, 743	659, 438	2, 640, 024	2, 586, 672
Barley ....do..	4, 202, 596	5, 309, 385	2, 415, 126	3, 941, 718	6, 214, 017	8, 121, 878	9, 698, 072
Total............	175, 107, 004	182, 828, 181	186, 715, 358	202, 381, 827	189, 457, 404	222, 711, 115	209, 459, 914

The operations of our leading currents of trade in breadstuffs, as shown above, fell off from the high aggregates of the previous year, but with that exception they were the largest in our history. Wheat and barley were marketed in increased quantities, but all other articles declined, especially flour and oats. The exports of flour and wheat declined over 17,000,000 bushels, which will account for the decreased eastward movement of those articles. The exports of corn increased over 20,000,000 bushels, yet its eastward movement shows a slight decline. The exports

of oats more than doubled, yet the eastward shipment fell off 20 per cent. But of this crop, as well as of barley and rye, the proportion required by our foreign trade is very small. The great mass of our eastward cereal movement is absorbed by domestic consumption.

The following table shows the annual receipts and eastward shipments of flour and grain from the seven leading lake and river ports of the West, viz: Chicago, Milwaukee, Toledo, Detroit, Cleveland, Peoria, Saint Louis, and Duluth, for the last five calendar years:

Products.	1873.		1874.		1875.	
	Receipts.	Shipments.	Receipts.	Shipments.	Receipts.	Shipments.
Flour....bbls.	6, 332, 259	6, 445, 394	6, 159, 574	5, 827, 056	5, 022, 510	5, 539, 965
Wheat....bush.	68, 108, 613	57, 995, 184	78, 860, 187	60, 301, 991	70, 669, 657	57, 899, 899
Flour and wheat....do..	99, 769, 908	89, 221, 154	109, 658, 057	89, 437, 271	95, 782, 207	85, 599, 724
Corn....do..	61, 249, 356	49, 776, 823	57, 393, 142	44, 572, 481	48, 989, 721	43, 979, 250
Oats....do..	30, 208, 074	21, 482, 214	26, 842, 681	16, 701, 265	25, 341, 390	19, 322, 370
Rye....do..	1, 763, 177	1, 348, 469	1, 598, 943	2, 994, 947	2, 829, 494	927, 340
Barley....do..	6, 394, 538	4, 259, 376	6, 554, 296	3, 061, 182	6, 233, 151	2, 814, 470
Total....	199, 335, 053	167, 089, 026	202, 047, 119	156, 767, 156	179, 175, 963	152, 143, 154

Products.	1876.		1877.	
	Receipts.	Shipments.	Receipts.	Shipments.
Flour....bbls.	5, 578, 950	4, 997, 845	5, 107, 531	5, 340, 423
Wheat....bush.	55, 834, 141	48, 799, 613	53, 776, 909	44, 633, 537
Flour and wheat....do..	83, 728, 891	73, 798, 838	79, 314, 564	71, 335, 652
Corn....do..	81, 054, 244	75, 010, 881	77, 995, 208	67, 587, 819
Oats....do..	24, 881, 498	20, 093, 245	23, 337, 031	17, 976, 642
Rye....do..	2, 854, 900	2, 511, 047	4, 979, 944	2, 372, 660
Barley....do..	8, 937, 089	3, 947, 086	9, 342, 646	5, 815, 685
Total....	201, 456, 627	175, 351, 097	194, 969, 393	165, 088, 458

The eastward shipments from these ports show a falling off of nearly ten million bushels, yet they maintain their proportion, about 80 per cent., of the receipts at the seven outports as in the three years next preceding, indicating that no great revolutionary changes have taken place in the leading lines of this internal commerce. The remaining 20 per cent. of the receipts of the outports is made up of shipments from points farther south and east. The western ports shipped nearly 85 per cent. of their entire receipts against 87 per cent. in 1876, 85 per cent. in 1875, 77 per cent. in 1874, and 83 per cent. in 1873. Their shipments of flour being somewhat greater than their receipts, indicate a large proportion of domestic manufacture.

The receipts and shipments of flour and grain at the great leading markets during the last five years were as shown in the following tables:

FLOUR, BARRELS.

Cities.	1873.		1874.		1875.		1876.		1877.	
	Receipts.	Shipments.	Receipts.	Shipments.	Receipts.	Shipments.	Receipts.	Shipments.	Receipts.	Shipments.
New York	3, 546, 568	1, 655, 331	4, 017, 207	2, 462, 723	3, 941, 331	1, 953, 667	4, 051, 665	1, 914, 183	3, 608, 788	1, 513, 733
Boston	1, 795, 272	231, 361	1, 890, 487	287, 718	1, 637, 972	271, 170	1, 836, 985	268, 093	1, 860, 223	231, 370
Philadelphia	954, 680	142, 386	915, 636	185, 698	922, 190	160, 748	970, 781	192, 433	740, 330	....
Baltimore	1, 312, 612	359, 566	1, 560, 997	474, 758	1, 391, 843	453, 000	1, 389, 538	426, 094	1, 322, 709	369, 519
Cincinnati*	765, 469	560, 829	774, 916	551, 774	697, 578	473, 460	636, 504	396, 217	540, 128	296, 373
Chicago	2, 487, 376	2, 303, 490	2, 666, 679	2, 306, 576	2, 625, 883	2, 285, 113	2, 955, 197	2, 634, 838	2, 749, 180	2, 568, 724
Milwaukee	1, 254, 821	1, 805, 200	1, 616, 338	2, 217, 579	1, 443, 801	2, 163, 346	2, 082, 688	2, 654, 028	....	....
Saint Louis†	1, 296, 457	2, 506, 215	1, 683, 898	2, 981, 760	1, 300, 381	2, 480, 877	1, 071, 434	2, 217, 578	....	....
San Francisco‡	222, 279	263, 645	469, 533	644, 710	461, 845	482, 551	457, 365	445, 143	514, 298	524, 885

* Commercial years ending August 31. † Receipts do not include home manufacture, which amounted in 1873 to 1,420,287 barrels; in 1874 to 1,581,000 barrels; in 1875.
‡ At San Francisco, the statistics embrace "harvest years," each ending June 30; the flour barrel here contains 200 pounds.

WHEAT, BUSHELS.

Cities.	1873.		1874.		1875.		1876.		1877.	
	Receipts.	Shipments.	Receipts.	Shipments.	Receipts.	Shipments.	Receipts.	Shipments.	Receipts.	Shipments.
New York	35, 559, 870	27, 801, 829	41, 817, 215	33, 541, 740	34, 214, 768	26, 193, 693	27, 042, 164	24, 358, 295	24, 691, 237	21, 121, 604
Boston	880, 747	486, 128	1, 362, 017	1, 062, 366	1, 035, 109	734, 941	504, 767	112, 915	2, 061, 579	1, 612, 814
Philadelphia	4, 372, 800	1, 938, 310	5, 471, 700	3, 289, 532	5, 550, 800	3, 302, 054	4, 485, 000	2, 989, 704	4, 107, 400	....
Baltimore	2, 810, 917	1, 158, 097	6, 456, 834	3, 556, 848	4, 409, 670	2, 046, 430	3, 945, 247	1, 659, 861	7, 331, 540	4, 514, 781
Cincinnati	860, 454	412, 722	1, 221, 176	783, 990	1, 135, 388	600, 622	1, 052, 952	558, 252	1, 436, 851	961, 754
Chicago	26, 266, 562	24, 455, 657	29, 764, 622	27, 634, 587	24, 206, 370	23, 184, 349	16, 574, 058	14, 361, 950	14, 350, 658	15, 096, 123
Milwaukee	28, 457, 937	24, 994, 266	25, 628, 143	22, 255, 380	27, 878, 727	22, 681, 020	18, 174, 817	16, 804, 394	....	....
Saint Louis	6, 185, 038	1, 210, 286	8, 255, 221	1, 938, 841	7, 604, 265	1, 562, 453	8, 037, 574	2, 630, 007	....	....
San Francisco	17, 968, 158	16, 371, 147	13, 049, 702	12, 122, 068	16, 346, 293	14, 655, 590	10, 995, 480	10, 227, 448	18, 005, 127	17, 525, 173

WHEAT, INCLUDING FLOUR REDUCED TO BUSHELS OF WHEAT.

Cities.	1873.		1874.		1875.		1876.		1877.	
	Receipts.	Shipments.	Receipts.	Shipments.	Receipts.	Shipments.	Receipts.	Shipments.	Receipts.	Shipments.
New York	53, 292, 710	36, 078, 484	61, 903, 250	45, 855, 355	53, 921, 423	35, 962, 028	47, 300, 489	33, 929, 210	42, 735, 177	28, 690, 269
Boston	9, 857, 107	1, 642, 933	10, 814, 452	2, 500, 956	9, 224, 969	2, 140, 791	9, 689, 692	1, 453, 320	11, 362, 694	2, 769, 664
Philadelphia	9, 146, 200	2, 650, 240	10, 049, 880	4, 218, 022	10, 161, 750	4, 105, 794	9, 338, 905	3, 951, 869	7, 809, 050	....
Baltimore	9, 373, 977	2, 955, 927	14, 261, 819	5, 930, 638	11, 368, 885	4, 311, 430	10, 892, 937	3, 790, 331	13, 945, 085	6, 462, 376
Cincinnati	4, 687, 799	3, 216, 867	5, 095, 756	3, 542, 860	4, 623, 278	2, 967, 922	4, 235, 472	2, 539, 337	4, 137, 491	2, 443, 619
Chicago	38, 703, 442	35, 973, 107	43, 098, 017	39, 167, 467	37, 335, 785	34, 609, 914	31, 350, 043	27, 536, 140	28, 096, 558	27, 939, 743
Milwaukee	34, 732, 042	34, 020, 266	33, 709, 833	33, 343, 275	35, 097, 732	33, 497, 750	28, 588, 257	30, 074, 534	....	....
Saint Louis	12, 667, 323	13, 741, 361	16, 674, 711	16, 847, 641	14, 106, 170	13, 966, 838	13, 394, 744	13, 717, 897	....	....
San Francisco	19, 079, 553	17, 689, 372	15, 397, 367	15, 343, 618	18, 655, 518	17, 068, 345	13, 282, 305	12, 453, 163	20, 577, 063	20, 149, 598

CORN, BUSHELS.

Cities.	1873.		1874.		1875.		1876.		1877.	
	Receipts.	Shipments.	Receipts.	Shipments.	Receipts.	Shipments.	Receipts.	Shipments.	Receipts.	Shipments.
New York	24, 576, 345	15, 416, 787	29, 329, 000	26, 447, 807	22, 488, 707	12, 955, 525	26, 899, 162	16, 877, 251	34, 625, 138	26, 322, 834
Boston	3, 558, 363	162, 739	3, 303, 641	380, 254	5, 346, 340	1, 551, 776	9, 005, 375	4, 160, 817	7, 362, 718	3, 182, 844
Philadelphia	8, 233, 400	2, 002, 368	5, 954, 700	2, 203, 588	7, 130, 000	4, 601, 586	20, 261, 675	16, 790, 691	13, 926, 300	....
Baltimore	8, 330, 449	6, 003, 618	9, 355, 567	5, 959, 757	9, 567, 141	6, 989, 807	24, 684, 230	20, 953, 724	21, 142, 399	19, 353, 047
Cincinnati	2, 259, 544	324, 183	3, 457, 164	658, 718	3, 695, 561	595, 915	4, 115, 564	1, 028, 325	4, 559, 506	1, 317, 142
Chicago	38, 157, 232	36, 754, 943	35, 799, 638	32, 705, 224	28, 341, 150	26, 443, 884	48, 668, 640	45, 629, 035	46, 306, 473	46, 532, 795
Milwaukee	921, 391	197, 920	1, 313, 642	556, 563	949, 695	226, 895	798, 458	96, 908	....	....
Saint Louis	7, 858, 299	6, 695, 860	7, 130, 057	5, 760, 040	6, 837, 087	5, 205, 570	15, 320, 981	14, 018, 817	....	....
San Francisco	....	....	....	....	....	....	....	....	....	....

OATS, BUSHELS.

Cities.	1873. Receipts.	1873. Shipments.	1874. Receipts.	1874. Shipments.	1875. Receipts.	1875. Shipments.	1876. Receipts.	1876. Shipments.	1877. Receipts.	1877. Shipments.
New York	11, 235, 420	49, 573	10, 792, 919	122, 528	10, 636, 078	138, 508	12, 251, 265	624, 431	12, 179, 657	252, 749
Boston	3, 663, 364	....	3, 087, 269	....	2, 833, 544	....	2, 622, 150	....	3, 108, 128	....
Philadelphia	5, 980, 565	....	4, 715, 000	30, 671	3, 820, 400	33, 800	4, 484, 000	861, 176	2, 505, 300	....
Baltimore	1, 255, 072	....	1, 149, 188	....	977, 514	....	810, 212	....	831, 179	....
Cincinnati	1, 520, 979	324, 718	1, 372, 464	216, 660	1, 323, 380	193, 242	1, 441, 158	321, 755	1, 096, 916	137, 286
Chicago	17, 888, 724	15, 694, 133	13, 901, 235	10, 561, 673	12, 916, 428	10, 279, 134	13, 030, 121	11, 271, 642	13, 432, 095	12, 721, 435
Milwaukee	1, 763, 058	990, 525	1, 403, 889	726, 039	1, 643, 132	1, 160, 450	1, 745, 673	1, 377, 560	....	....
Saint Louis	5, 359, 853	3, 215, 206	5, 296, 967	3, 027, 663	5, 006, 850	2, 877, 035	3, 660, 912	1, 932, 983	....	....
San Francisco	334, 242	9, 062	405, 667	46, 067	509, 740	95, 038	389, 933	5, 168	350, 428	7, 465

RYE, BUSHELS.

Cities.	1873. Receipts.	1873. Shipments.	1874. Receipts.	1874. Shipments.	1875. Receipts.	1875. Shipments.	1876. Receipts.	1876. Shipments.	1877. Receipts.	1877. Shipments.
New York	995, 447	1, 069, 140	592, 114	641, 661	301, 654	206, 898	1, 627, 007	1, 336, 423	1, 960, 607	2, 051, 563
Boston	33, 335	....	34, 273	....	27, 878	....	34, 594	....	38, 771	....
Philadelphia	270, 600	....	210, 191	104, 616	187, 550	....	679, 100	431, 223	334, 870	....
Baltimore	100, 519	....	118, 634	....	74, 529	....	112, 160	....	116, 709	....
Cincinnati	426, 660	61, 577	385, 934	117, 349	336, 410	98, 245	500, 515	178, 403	427, 145	148, 263
Chicago	1, 189, 464	960, 613	701, 182	335, 077	699, 583	310, 592	1, 447, 917	1, 433, 976	1, 740, 530	1, 577, 172
Milwaukee	376, 634	255, 928	284, 522	74, 879	230, 834	98, 923	354, 859	220, 964	....	....
Saint Louis	356, 580	206, 652	288, 743	166, 133	275, 200	134, 960	399, 826	304, 192	....	....
San Francisco	....	....	....	....	....	....	....	....	....	....

BARLEY, BUSHELS.

Cities.	1873.		1874.		1875.		1876.		1877.	
	Receipts.	Shipments.	Receipts.	Shipments.	Receipts.	Shipments.	Receipts.	Shipments.	Receipts.	Shipments.
New York	2, 444, 206	40, 040	2, 770, 000	3, 560	4, 710, 598	110	6, 779, 532	87, 958	8, 798, 238	2, 412, 398
Boston	332, 849	....	418, 615	....	530, 539	....	798, 689	....	829, 402	....
Philadelphia	1, 066, 392	....	1, 236, 392	....	1, 652, 700	....	1, 329, 200	....	962, 400	....
Baltimore	....	....	....	....	....	....	....	....	....	....
Cincinnati	1, 228, 245	37, 456	1, 084, 500	90, 688	1, 109, 693	82, 733	1, 551, 944	232, 556	1, 258, 163	152, 412
Chicago	4, 240, 239	3, 366, 041	3, 354, 981	2, 404, 538	3, 107, 297	1, 868, 206	4, 716, 360	2, 687, 932	5, 031, 260	4, 381, 857
Milwaukee	1, 209, 474	688, 455	1, 083, 472	464, 837	1, 286, 585	867, 970	1, 857, 208	1, 235, 481	....	....
Saint Louis	1, 158, 615	125, 604	1, 421, 406	227, 418	1, 171, 337	146, 330	1, 492, 985	223, 680	....	....
San Francisco	1, 878, 983	406, 263	2, 072, 762	303, 570	1, 903, 590	340, 227	2, 537, 942	471, 452	928, 747	128, 898

ALL GRAINS, INCLUDING FLOUR REDUCED, BUSHELS.

Cities.	1873. Receipts.	1873. Shipments.	1874. Receipts.	1874. Shipments.	1875. Receipts.	1875. Shipments.	1876. Receipts.	1876. Shipments.	1877. Receipts.	1877. Shipments.
New York	92, 544, 128	52, 654, 024	105, 387, 283	73, 070, 911	92, 058, 460	49, 263, 069	94, 857, 455	52, 855, 273	100, 298, 817	59, 729, 813
Boston	17, 445, 018	....	17, 608, 250	....	17, 963, 270	....	22, 150, 500	....	22, 701, 713	....
Philadelphia	24, 697, 157	....	22, 166, 163	....	22, 952, 406	....	36, 092, 880	....	25, 537, 920	....
Baltimore	19, 060, 017	....	24, 885, 208	....	21, 988, 069	....	36, 499, 539	....	36, 045, 372	....
Cincinnati	10, 123, 227	3, 964, 801	11, 395, 818	4, 626, 275	11, 088, 322	3, 938, 057	11, 844, 653	4, 300, 376	11, 479, 221	4, 198, 722
Chicago	100, 179, 101	92, 748, 837	96, 945, 053	85, 173, 979	82, 400, 243	73, 511, 730	99, 213, 081	88, 558, 725	94, 606, 916	93, 153, 002
Milwaukee	39, 001, 599	36, 153, 094	37, 795, 358	35, 165, 593	39, 207, 888	35, 851, 988	33, 344, 455	33, 005, 447	....	....
Saint Louis	27, 400, 670	23, 984, 683	30, 811, 884	26, 028, 895	27, 396, 644	22, 330, 733	34, 269, 448	30, 197, 569	....	....
San Francisco	....	....	....	....	....	....	....	....	....	....

MARKET PRICES OF FARM

The following statistics represent the state of the market, as

Products.	January.	February.	March.	April.	May.
NEW YORK.					
Flour:					
Superfine, State and Western..........bbl.	$5 30 to $5 50	$5 50 to $5 80	$5 30 to $5 60	$5 75 to $6 15	$7 25 to $7 85
Extra to choice State.do..	5 65 to 7 00	6 75 to 8 00	5 70 to 8 25	6 15 to 8 25	8 00 to 10 50
Extra to choice Western..............bbl.	5 65 to 8 50	5 75 to 8 75	6 00 to 10 00	6 20 to 8 40	8 25 to 10 50
Extra to choice Northwestern...........bbl.	6 85 to 9 50	6 90 to 10 00	5 80 to 10 00	6 20 to 10 50	8 25 to 12 00
Extra Southern ....do..	5 75 to 6 75	5 80 to 6 25	6 25 to 7 56	6 40 to 7 00	8 50 to 9 25
Southern family....do..	6 85 to 8 75	7 05 to 8 75	7 50 to 8 50	7 25 to 8 50	9 50 to 11 00
Wheat:					
No. 1 spring.......bush.	Nominal.....	1 45..........	1 46 to 1 48	1 51 to 1 53	2 00 to 2 05
No. 2 spring.......do..	1 40 to 1 43	1 40 to 1 43	1 38 to 1 44	1 45 to 1 50	1 85 to 1 95
Winter, red, West'n.do..	..........1 45	..........1 53	1 30 to 1 45	1 35 to 1 50	1 70 to 2 00
Winter, amber, Western..............bush.	Nominal.....	Nominal.....	1 50 to 1 60	1 55 to 1 65	2 05 to 2 10
Winter, white, Western..............bush.	Nominal.....	Nominal.....	1 40 to 1 60	1 50 to 1 70	2 00 to 2 25
Corn..................do..	61 to 64	59½ to 62	57 to 62	54 to 59	66 to 70
Oats ....do..	38 to 48	40 to 55	42 to 56	42 to 51	55 to 72
Rye ....do..	83 to 94	82 to 93	80 to 88	80 to 90	1 05 to 1 20
Barley.................do..	75 to 1 14	95 to 1 13	65 to 1 05	65 to 95	70 to 1 10
Hay:					
Baled, first quality..ton.	14 00 to 20 00	16 00 to 21 00	15 00 to 19 00	15 00 to 19 00	15 00 to 20 00
Baled, second quality, for shipping ......ton.	13 00 to 14 00	15 00..........	14 00 to 15 00	14 00..........	14 00 to 15 00
Beef:					
Mess................bbl.	10 00 to 11 50	10 50 to 11 00	10 50 to 12 00	10 50 to 12 00	12 50 to 13 00
Extra mess.........do..	12 00 to 12 50	12 00 to 12 50	12 00 to 13 50	12 00 to 13 00	14 00 to 14 50
Pork:					
Mess ....bbl.	17 85 to 18 25	17 25 to 17 80	14 20 to 14 25	14 50 to 14 65	16 00 to 16 50
Extra prime ....do..	Inactive	13 75 to 14 00	10 50 to 11 00	11 75..........	12 50 to 13 00
Prime mess.........do..	Inactive	16 50 to 16 75	14 00..........	13 75..........	15 00 to 15 50
Lard...............cental.	11 20 to 11 50	11 15 to 11 20	8 00 to 9 75	8 50 to 10 25	10 00 to 10 62½
Butter:					
Western ....lb.	16 to 27	16 to 38	12 to 23	12 to 35	22 to 25
State ....do.	24 to 38	25 to 35	12 to 22	16 to 28	13 to 25
Cheese:					
State factory.........lb.	11 to 14½	4 to 14¾	7½ to 9½	10½ to 15½	10 to 14
Western factory.....do.	10 to 14	4 to 14½	5 to 8½	10 to 15	7½ to 13½
Sugar, fair to prime refining ....lb.	9½ to 9¾	9¼ to 9⅝	9⅝ to 9⅞	8⅝ to 9	9½ to 9⅞
Cotton:					
Ordinary to good ordinary ....lb.	10¼ to 10⅝	11 7/16 to 12 5/16	10 13/16 to 11 11/16	9 13/16 to 10 11/16	9 3/16 to 10 1/16
Low middling to good middling ....lb.	12⅛ to 13⅛	12⅝ to 13½	12 to 12⅞	11 to 11⅞	10⅜ to 11¼
Tobacco:					
Lugs..................lb.	5 to 8	5 to 8	4½ to 7½	4½ to 7½	4½ to 6½
Leaf, common to medium................lb.	8 to 11	8 to 11	6½ to 11	6½ to 11	6½ to 11
Wool:					
American XXX and pick code ....lb.	48 to 50	50 to 52	50 to 53	50 to 53	50 to 53
American X and XX.do.	36 to 48	36 to 48	35 to 48	35 to 48	35 to 48
American combing ..do.	48 to 57	50 to 56	37 to 52	37 to 52	37 to 52
California spring clip.do.	13 to 28	13 to 31	15 to 30	16 to 28	16 to 28
California fall clip...do.	12 to 22	12 to 23	12 to 23	13 to 22	13 to 22
Pulled ....do.	35 to 38	24 to 40	23 to 45	20 to 43	20 to 43
BOSTON.					
Flour:					
Western, spring, superfine...............bbl.	4 75 to 5 25	5 00 to 5 50	5 00 to 5 50	5 25 to 5 75	7 00 to 8 00
Common, spring extras ....bbl.	5 50 to 6 00	6 75 to 6 25	5 75 to 6 25	6 25 to 6 75	8 75 to 9 25
Good to fancy, Northwestern spring ...bbl.	6 00 to 10 00	6 50 to 10 50	6 25 to 10 50	6 50 to 10 25	9 25 to 13 00
Good to fancy, Western winter............bbl.	6 50 to 9 25	7 00 to 9 50	7 00 to 9 25	7 00 to 9 00	10 00 to 12 00
Southern family ....do..	7 00 to 9 25	7 50 to 9 50	7 00 to 9 25	7 50 to 9 00	10 50 to 12 00
Wheat ....bush.	1 35 to 1 55	1 35 to 1 65	1 35 to 1 65	1 42 to 1 65	1 55 to 2 30
Corn ....do..	66 to 71	64 to 68	57½ to 61½	55 to 59	74 to 78
Oats...................do..	42 to 57	43 to 58	38 to 56	39 to 59	49 to 70
Rye ....do..	90 to 95	95 to 1 00	90	85 to 90	1 20 to 1 25

PRODUCTS IN 1877.

nearly as practicable, at the beginning of each month.

June.	July.	August.	September.	October.	November.	December.
\$5 75 to \$6 25	\$5 40 to \$5 90	\$5 25 to \$5 65	\$4 15 to \$4 50	\$5 00 to \$5 50	\$4 75 to \$5 25	\$4 75 to \$5 25
6 50 to 9 25	6 25 to 9 25	5 90 to 8 50	5 10 to 7 75	5 75 to 6 50	5 50 to 6 00	5 45 to 7 25
7 00 to 9 25	7 00 to 9 75	6 15 to 8 75	5 15 to 7 75	6 00 to 10 00	5 40 to 9 00	5 60 to 7 25
6 75 to 11 00	6 40 to 11 00	6 00 to 9 75	5 35 to 9 00	6 50 to 9 00	5 75 to 9 50	5 50 to 8 75
7 00 to 7 25	7 25 to 8 00	6 25 to 7 25	5 50 to 6 50	5 50 to 7 50	5 75 to 7 00	5 65 to 6 15
8 00 to 10 00	8 25 to 10 25	7 50 to 9 00	6 75 to 8 00	7 50 to 9 25	7 00 to 8 75	6 25 to 7 50
1 80 to 1 85	1 70 to 1 75	1 65	1 35 to 1 40	1 43 to 1 45	1 30 to 1 36	1 33 to 1 35
1 65 to 1 75	1 58 to 1 65	1 53 to 1 60	1 28 to 1 33	1 $37\frac{1}{2}$ to 1 40	1 $27\frac{1}{4}$ to 1 $28\frac{1}{2}$	1 $29\frac{1}{2}$ to 1 31
1 50 to 1 70	1 50 to 1 80	1 45 to 1 52	1 25 to 1 38	1 45 to 1 53	1 35 to 1 40	1 36 to 1 44
1 80 to 1 90	1 90 to 2 00	1 55 to 1 60	1 32 to 1 40	1 45 to 1 55	1 40 to 1 41	1 40 to 1 46
1 75 to 2 00	1 85 to 2 10	1 60 to 1 65	1 35 to 1 47	1 50 to 1 58	1 45 to 1 52	1 43 to 1 56
54 to 63	54 to 67	56 to 63	52 to 60	55 to 59	58 to 66	58 to 65
41 to 68	33 to 60	36 to 60	29 to 37	32 to 47	36 to $41\frac{1}{2}$	38 to 43
80 to 1 00	75 to 95	69 to 85	65 to 80	68 to 81	70 to 76	73 to 78
70 to 1 10	90 to 1 10	90 to 1 30	....	80 to 1 00	50 to 1 00	75 to 1 03
15 00 to 20 00	15 00 to 19 00	14 00 to 20 00	15 00 to 19 00	13 00 to 17 00	12 00 to 17 00	15 00 to 18 00
14 00 to 15 00	14 00 to 15 00	12 00 to 15 00	12 00 to 14 00	10 00 to 12 00	11 00 to 12 00	12 00 ....
13 00 to 14 00	13 00 to 14 00	13 00 to 14 00	13 00 to 14 00	13 00 to 14 00	12 00 to 13 00	11 75 to 12 25
.........14 50	14 00 to 14 50	14 00 to 14 50	14 00 to 14 50	14 00 to 14 50	13 00 to 14 00	12 75 to 13 25
14 65	14 20 to 14 25	14 25 to 14 30	13 00	14 35 to 14 40	14 25 to 14 30	13 25 ....
11 50 to 12 00	10 50 to 11 00	....	10 00 to 10 50	12 00 to 13 00	10 00 to 10 50	9 00 to 9 75
14 00 to 14 50	14 00	....	12 75	....	12 00 to 13 50	10 00 to 11 00
7 $62\frac{1}{2}$ to 10 $12\frac{1}{2}$	8 00 to 9 75	9 15 to 10 00	8 75 to 9 50	6 50 to 9 $87\frac{1}{2}$	5 25 to 9 $37\frac{1}{2}$	6 00 to 9 00
14 to 23	12 to 23	12 to 26	12 to 25	15 to 28	15 to 32	13 to 32
19 to 23	12 to 22	12 to 27	12 to 26	16 to 30	16 to 33	14 to 33
10 to 13	$7\frac{1}{2}$ to $9\frac{1}{2}$	$7\frac{1}{2}$ to $10\frac{1}{4}$	$7\frac{1}{2}$ to $12\frac{1}{4}$	$7\frac{1}{2}$ to $12\frac{3}{4}$	$7\frac{1}{2}$ to $13\frac{1}{2}$	$7\frac{1}{2}$ to $12\frac{2}{3}$
7 to 12	5 to $8\frac{1}{2}$	6 to 9	5 to $11\frac{1}{2}$	5 to 13	5 to 13	5 to 13
$10\frac{1}{8}$ to $10\frac{1}{2}$	$9\frac{5}{8}$ to $9\frac{7}{8}$	$8\frac{7}{8}$ to $9\frac{1}{8}$	$8\frac{1}{8}$ to $8\frac{1}{2}$	$8\frac{1}{8}$ to $8\frac{1}{2}$	$7\frac{3}{4}$ to 8	$7\frac{1}{8}$ to $7\frac{3}{8}$
$9\frac{1}{2}$ to $10\frac{3}{8}$	$10\frac{13}{16}$ to $11\frac{9}{16}$	$10\frac{9}{16}$ to $11\frac{5}{16}$	$9\frac{9}{16}$ to $10\frac{5}{16}$	$9\frac{7}{8}$ to $10\frac{5}{8}$	$9\frac{3}{4}$ to $10\frac{1}{2}$	$9\frac{7}{8}$ to $10\frac{11}{16}$
$10\frac{11}{16}$ to $11\frac{9}{16}$	$11\frac{7}{8}$ to $12\frac{5}{8}$	$11\frac{5}{8}$ to $12\frac{1}{8}$	$10\frac{5}{8}$ to $11\frac{3}{8}$	$10\frac{7}{8}$ to $11\frac{3}{8}$	$13\frac{13}{16}$ to $11\frac{5}{8}$	$11\frac{1}{16}$ to $11\frac{3}{4}$
$4\frac{1}{2}$ to $6\frac{1}{2}$	4 to 9	4 to 9	$3\frac{1}{2}$ to 9	3 to 9	3 to $5\frac{7}{8}$	3 to 5
$6\frac{1}{2}$ to 11	$5\frac{1}{2}$ to 12	$7\frac{1}{2}$ to $12\frac{1}{2}$	$7\frac{1}{2}$ to 13	$7\frac{1}{2}$ to 13	$4\frac{1}{2}$ to 9	$4\frac{1}{2}$ to 9
48 to 50	52 to 55	52 to 55	50 to 53	50 to 53	50 to 54	50 to 52
35 to 46	38 to 50	38 to 52	38 to 49	38 to 49	38 to 48	37 to 47
47 to 52	48 to 56	48 to 56	50 to 57	50 to 60	49 to 57	48 to 54
14 to 30	13 to 35	13 to 35	16 to 30	16 to 30	13 to 30	13 to 30
12 to 21	10 to 25	10 to 25	18 to 22	18 to 22	10 to 23	10 to 22
18 to 37	20 to 40	20 to 40	30 to 36	30 to 36	20 to 40	18 to 42
6 00 to 6 50	5 75 to 6 50	4 75 to 5 50	4 00 to 4 50	4 00 to 5 00	4 50 to 5 00	4 25 to 4 75
7 00 to 7 50	6 50 to 7 50	6 00 to 7 00	5 00 to 5 50	5 50 to 6 00	5 25 to 6 00	5 00 to 5 50
7 50 to 11 50	7 00 to 11 00	6 50 to 10 00	5 50 to 8 50	6 00 to 9 50	5 50 to 9 25	5 50 to 9 25
9 00 to 10 50	9 00 to 10 50	7 50 to 9 50	5 50 to 8 00	6 75 to 8 25	6 50 to 8 75	6 50 to 8 00
9 00 to 10 50	9 00 to 10 50	8 00 to 9 50	7 00 to 8 50	7 00 to 8 75	6 50 to 8 75	6 50 to 8 75
1 25 to 2 05	1 10 to 2 15	1 31 to 1 80	1 20 to 1 45	1 27 to 1 58	1 $27\frac{1}{2}$ to 1 54	1 27 to 1 56
61 to 64	59 to 66	66 to 71	58 to 62	63 to 67	65 to 69	63 to 71
43 to 65	43 to 68	35 to 69	20 to 45	34 to 45	35 to 48	$38\frac{1}{2}$ to 48
95 to 1 00	95 to 1 00	80 to 85	65 to 70	75 to 80	80 to 82	78 to 80

MARKET PRICES OF FARM

Products.	January.	February.	March.	April.	May.
BOSTON—Continued.					
Barley ....bush.	$0 75 to $1 05	$0 75 to $1 12½	$0 70 to $1 05	$0 70 to $1 05	$0 70 to $1 15
Hay:					
Eastern and Northern ....ton.	12 00 to 20 00	12 00 to 21 00	12 00 to 20 00	12 00 to 20 00	12 00 to 20 00
Western choice timothy ....ton.	....	....	16 00 to 18 00	17 00 to 19 00	17 00 to 19 00
Beef:					
Mess ....bbl.	11 50	11 00	11 00	11 00	12 00 ....
Extra mess ....do..	12 50	12 50	12 50	12 50	13 50 ....
Family ....do..	14 00 to 15 00	14 00 to 15 00	14 00 to 15 00	14 00 to 15 00	14 00 to 15 00
Pork:					
Mess ....bbl.	18 00 to 18 50	17 50 to 18 00	16 00 to 16 50	15 50 to 16 00	17 00 to 17 50
Prime ....do..	14 50 to 15 25	14 25 to 14 50	13 00 to 13 50	12 50 to 13 00	13 50 to 14 00
Lard ....lb.	11½ to 12	11¼ to 12½	11 to 11¾	10 to 11	11½ to 11¾
Butter:					
New York and Vermont ....lb.	18 to 33	18 to 30	15 to 25	17 to 25	12 to 23
Western ....do.	15 to 33	12 to 30	13 to 32	15 to 30	10 to 28
Cheese:					
New York and Vermont factory ....lb.	11 to 14½	11 to 15	12 to 15¼	13 to 15¼	10 to 14½
Western factory ....do.	10 to 14½	10 to 15	10 to 15¼	10 to 15¼	7 to 14½
Sugar, fair to good refining ....lb.	9½ to 9¾	9½	9¼ to 9½	8⅝ to 8¾	9⅜ to 9⅞
Cotton:					
Ordinary to good ordinary ....lb	10¼ to 11¼	11½ to 12¼	11 to 11¾	10 to 11	9½ to 10½
Low middling to good middling ....lb	12¼ to 13¼	12½ to 13¾	12¼ to 13⅛	11¼ to 12¼	10¾ to 11¾
Wool:					
Ohio and Pennsylv'a.lb.	40 to 52	40 to 52	38 to 52	36 to 50	36 to 50
Michigan ....do.	36 to 42	36 to 42	35 to 40	34 to 39	34 to 39
Other western ....do.	36 to 42	36 to 42	34 to 40	34 to 38	30 to 38
Pulled ....do.	20 to 47	20 to 42	20 to 45	20 to 43	20 to 43
Combing fleece ....do.	50 to 57½	50 to 57½	50 to 55	48 to 52	45 to 52
California ....do.	14 to 30	14 to 30	14 to 30	14 to 30	14 to 30
PHILADELPHIA.					
Flour:					
Superfine ....bbl.	4 00 to 4 50	4 50 to 5 00	4 50 to 5 00	4 50 to 5 00	6 50 to 6 75
Pennsylvania, extra to choice ....bbl.	4 50 to 7 25	5 25 to 7 50	5 25 to 7 50	5 75 to 7 50	6 75 to 10 50
Western, extra to choice ....bbl.	6 50 to 7 25	6 50 to 7 75	7 00 to 7 75	6 90 to 8 00	8 25 to 10 50
Wheat:					
White ....bush.	1 50 to 1 60	1 55 to 1 58	1 55 to 1 60	1 55 to 1 70	2 20 to 2 25
Amber ....do..	1 45 to 1 51	1 53 to 1 54	1 53 to 1 61	1 62 to 1 65	2 15 to 2 18
Red ....do..	1 35 to 1 46	1 35 to 1 50	1 35 to 1 55	1 35 to 1 63	1 90 to 2 10
Rye ....do..	77 to 81	79 to 82	75	75 to 77	1 05 to 1 10
Corn ....do..	54 to 81	55 to 82	54½ to 55	54 to 55	67 to 68
Oats ....do..	35 to 43	35 to 43	35 to 42	40 to 47	47 to 56
Hay:					
baled, prime ....ton..	16 00 to 19 00	16 00 to 19 00	14 00 to 16 00	14 00 to 16 00	16 00 to 20 00
baled, common to fair, shipping ....ton.	13 00 to 15 00	13 00 to 15 00	12 00 to 13 00	12 00 to 13 00	14 00 to 15 00
Beef:					
Western mess ....bbl	11 00	11 00	11 00	11 50	12 00 ....
Extra mess ....do..	12 00	12 00	12 00	....	....
Worthman's and Alborger's city family..bbl.	14 00	14 00	14 00	14 00	15 00 to 15 50
Pork:					
Mess ....bbl.	17 75 to 18 00	17 75 to 18 00	16 25 to 16 50	15 50	17 00 to 17 25
Prime mess ....do	16 50 to 16 75	16 00 to 16 50	16 00	14 50	16 00 ....
Extra prime ....do.	14 00 to 14 50	14 00 to 14 50	13 50	12 50	13 50 ....
Lard ....lb.	11 to 11½	10½ to 11¼	10 to 10¼	9¼ to 10	9½ to 11
Butter:					
Choice Middle State..lb.	26 to 31	26 to 31	25 to 28	20 to 29	22 to 24
Choice Western ....do.	21 to 27	25 to 27	23 to 25	21 to 26	23 to 24
Cheese:					
New York factory ...lb.	6 to 15	6 to 15	6 to 16	6 to 16	6 to 15
Ohio factory ....do.	14 to 14½	4 to 14¼	4 to 15	4 to 15¼	6 to 14½
Sugar, fair to good refining, Cuba ....lb.	9⅜ to 9⅝	9⅜ to 9⅝	9½ to 9⅞	8⅜ to 8⅞	9¼ to 10
Cotton:					
ordinary to good ordinary ....lb.	11½ to 12¼	11½ to 12¼	11 to 11⅞	9⅞ to 10¼	9½ to 10⅜

PRODUCTS IN 1877—Continued.

June.	July.	August.	September.	October.	November.	December.
....	....	....	....	$0 85 to $1 05	$0 70 to $0 98	$0 80 to $1 05
$12 00 to $21 00	$12 00 to $20 00	$12 00 to $20 00	$12 00 to $21 00	12 00 to 19 00	12 00 to 19 00	12 00 to 19 00
17 00 to 19 00	17 00 to 19 00	17 00 to 19 00	18 00 to 20 00	18 00 to 19 00	17 00 to 18 00	17 00 to 18 00
13 00	13 00	13 00	13 00	....	12 50 to 13 00	12 00 to 12 50
14 50	14 50	14 50	14 50	....	13 50 to 14 00	13 00 to 13 50
15 00 to 16 00	15 00 to 16 00	15 00 to 16 00	15 00 to 16 00	14 50 to 15 50	14 50 to 15 50	14 50 to 15 00
15 50 to 16 00	15 00 to 15 50	14 75 to 15 00	14 00 to 14 50	14 50 to 15 00	14 50 to 14 75	14 00 to 14 50
12 50 to 13 00	12 00 to 12 50	11 50 to 12 00	11 00 to 11 50	11 50 to 12 50	10 00 to 11 00	9 50 to 11 00
10½ to 11	9¾ to 10½	9¾ to 10⅛	9½ to 9¾	9½ to 10	9½ to 10	9 to 9¾
15 to 20	12 to 23	13 to 25	14 to 27	14 to 31	14 to 33	14 to 33
12 to 23	10 to 23	10 to 25	12 to 27	12 to 31	12 to 33	10 to 33
8 to 12½	5 to 10	6 to 11	8 to 11½	9 to 13	9 to 13½	9 to 13¼
7 to 12	4½ to 9⅛	6 to 10⅓	7 to 11	9 to 13	9 to 13	9 to 13
10⅛ to 10⅜	9½ to 9¾	9 to 9¼	8⅛ to 8⅜	8⅛ to 8⅜	8 to 8¼	7¼ to 7½
9¾ to 10⅝	10½ to 11⅛	10⅞ to 11¾	9½ to 10½	10 to 11	10 to 11	10 to 11
10¾ to 12	11⅝ to 12¾	12 to 13	10¾ to 11¾	11¼ to 12¼	11¼ to 12	11¼ to 12
36 to 50	42 to 55	43 to 57	38 to 55	38 to 52	37 to 50	37 to 50
34 to 40	38 to 45	40 to 45	37 to 43	37 to 42	35 to 42	35 to 42
34 to 39	38 to 45	40 to 44	37 to 42	37 to 42	35 to 41	35 to 41
20 to 43	20 to 43	20 to 45	20 to 45	20 to 43	20 to 43	20 to 43
45 to 52	52 to 55	53 to 57	52 to 55	53 to 57	45 to 56	45 to 57
15 to 32	20 to 38	20 to 38	20 to 38	15 to 37	15 to 34	15 to 34
6 25 to 6 50	5 50 to 6 50	5 50 to 5 75	4 50 to 4 75	4 75 to 5 00	4 50 to 4 75	4 25 to 4 50
6 75 to 9 25	6 75 to 9 25	6 50 to 9 62½	4 87½ to 7 00	5 50 to 7 37	5 00 to 6 75	5 25 to 6 75
7 75 to 9 50	7 50 to 9 25	7 50 to 9 25	6 50 to 7 00	6 25 to 8 00	6 00 to 6 75	5 50 to 6 75
1 90 to 2 00	2 10 to 2 20	1 35 to 1 60	1 45 to 1 50	1 45 to 1 55	1 45 to 1 50	1 45 to 1 55
.... 2 00	2 10 to 2 20	1 55 to 1 60	1 40 to 1 43	1 50 to 1 54	1 45 to 1 46	1 45 to 1 48
1 60 to 1 95	2 10 to 2 20	1 50 to 1 60	1 30 to 1 36	1 44 to 1 48	1 40 to 1 42	1 40 to 1 43
80	85 to 91	70 to 78	60	68 to 70	68 to 76	70 to 75
58 to 62	61 to 64	61 to 65	56 to 60	57 to 60	60 to 62	64 to 66
41 to 47	41 to 50	35 to 45	27 to 33	32 to 37	32 to 38½	35 to 39
16 00 to 20 00	13 00 to 18 00	15 00 to 20 00	16 00 to 18 00	15 00 to 17 00	14 00 to 16 00	15 00 to 16 00
14 00 to 15 00	12 00 to 13 00	12 00 to 14 00	12 00 to 13 00	12 00 to 13 00	11 00 to 13 00	11 00 to 13 00
11 50	12 00	11 50	11 50	12 00	13 00	12 50 ....
....	....	....	....	....	....	....
15 00 to 15 50	14 00	14 00	14 00	14 00	15 00 to 16 00	15 00 to 15 50
15 50	14 50 to 15 00	15 00 to 15 50	14 25 to 14 50	14 50 to 15 00	14 75 to 15 00	14 00 to 14 50
13 00	12 50	14 50	13 00 to 13 50	14 00	14 00	12 50 ....
12 00	12 00	11 50	11 00	11 00 to 11 52	11 00 to 11 25	12 00 to 12 50
8½ to 10	8½ to 9¾	8¼ to 9¼	8¼ to 9¼	8¼ to 9¼	8¼ to 9½	7½ to 8¼
19 to 23	19 to 21	22 to 25	22 to 25	26 to 30	25 to 32	22 to 34
16 to 22	16 to 21	18 to 23	22 to 24	22 to 27	21 to 31	22 to 25
5 to 13	4 to 9½	5 to 11	4 to 10	6 to 13¾	6 to 13¾	6 to 13½
5 to 11½	4 to 8¼	5 to 10½	7½ to 8½	6 to 13	6 to 13	6 to 13¼
10⅛ to 10⅜	9⅝ to 9¾	8⅝ to 8⅞	8⅛ to 8⅜	8⅛ to 8⅜	7¼ to 8	7¼ to 7½
9¾ to 10⅝	10⅛ to 11⅜	10½ to 11¼	9⅞ to 10⅝	10⅛ to 10⅞	9⅞ to 10⅝	9⅞ to 10⅝

MARKET PRICES OF FARM

Products.	January.	February.	March.	April.	May.
PHILADELPHIA—Cont'd.					
Cotton—Continued.					
low middling to good middling .... lb.	$0 12⅝ to $0 13¾	$0 12⅝ to $0 13⅛	$0 12⅛ to $0 13⅛	$0 11⅛ to $0 12	$0 10¾ to $0 11⅝
Wool:					
Pennsylvania and Ohio clothing .... lb.	28 to 47	28 to 47	28 to 47	28 to 47	26 to 46
Pennsylvania and Ohio combing .... lb.	38 to 57	28 to 57	37 to 55	37 to 55	34 to 51
New York, Michigan, and Wisconsin ..... lb.	35 to 42	35 to 42	35 to 42	35 to 42	33 to 38
other Northwestern . do.	28 to 40	28 to 40	28 to 40	28 to 40	24 to 38
pulled .... do.	22 to 57	22 to 57	22 to 57	20 to 55	22 to 53
tub-washed .... do.	25 to 45	25 to 45	25 to 44	25 to 44	23 to 38
California .... do.	14 to 27	14 to 27	14 to 27	13 to 26	12 to 25
Colorado .... do.	13 to 22	13 to 22	13 to 17	12 to 21	14 to 18
BALTIMORE.					
Flour:					
Superfine .... bbl.	5 00 to 5 25	5 00 to 5 75	5 10 to 5 75	5 25 to 6 25	6 50 to 7 50
Extra .... do.	5 75 to 6 25	6 00 to 6 50	6 00 to 6 50	6 50 to 7 00	8 00 to 9 50
Family .... do.	6 75 to 9 00	6 75 to 9 50	6 75 to 9 50	7 25 to 9 75	9 50 to 11 50
Wheat:					
Red .... bush.	1 45 to 1 60	1 43 to 1 55	1 35 to 1 55	1 55 to 1 70	2 05 to 2 20
Amber .... do..	....	1 58 to 1 60	....	....	2 25 ....
White .... do..	1 40 to 1 60	1 50 to 1 55	1 55 to 1 60	1 67	....
Rye .... do..	72 to 75	70 to 72	70 to 72	72 to 75	1 05 to 1 10
Oats .... do..	34 to 41	37 to 43	37 to 41	40 to 45	50 to 55
Corn .... do..	51¼ to 60	55 to 59½	51 to 57	51½ to 54¾	61 to 70
Hay, Maryland and Pennsylvania .... ton.	16 00 to 19 00	15 00 to 19 00	15 00 to 19 00	15 00 to 19 00	16 00 to 21 00
Pork:					
Mess .... bbl.	17 75 to 18 00	17 50	16 50 to 17 00	15 50 to 16 00	17 00 ....
Extra prime .... do.	15 25	15 25	15 25	15 00	15 00 to 15 25
Lard .... lb.	11 to 11½	11¾ to 11¾	11 to 11½	10 to 10¾	10⅝ to 11¼
Butter:					
Western .... lb.	18 to 27	18 to 27	18 to 25	15 to 25	16 to 18
Eastern .... do.	18 to 28	18 to 23	15 to 22	15 to 23	10 to 23
Cheese:					
Western factory ..... lb.	9 to 14	9 to 15	9 to 15	9 to 15½	9 to 14½
Eastern factory ..... do.	13 to 15	13 to 15⅛	13 to 16½	13 to 16½	13 to 15⅓
Sugar:					
Fair to good refining . lb.	9½ to 9¾	9⅜ to 9⅝	9⅜ to 9⅝	8⅝ to 8⅞	9¾ to 10
New Orleans .... do.	8¾ to 9½	9 to 9¼	9 to 9¼	8¾ to 9½	9¼ to 10
Tobacco:					
Lugs .... lb.	6½ to 9	5 to 8½	5 to 8½	5 to 8½	4 to 7½
Leaf, common to medium .... lb.	7 to 11	7 to 11	7 to 11	7 to 11	6½ to 9
Cotton:					
Ordinary to good ordinary .... lb.	10½ to 11½	11 to 12	10½ to 11⅝	9½ to 10½	9¾ to 10½
Low middling to good middling .... lb.	12 to 13	12¼ to 13	11⅞ to 12⅝	10⅞ to 11⅞	10¾ to 11½
Wool:					
Tub-washed .... lb.	35 to 37	35 to 37	35 to 37	35 to 37	35 to 37
Fleece-washed .... do.	28 to 33	28 to 33	28 to 33	28 to 33	28 to 33
Pulled .... do.	23 to 35	23 to 35	23 to 35	23 to 35	23 to 35
Unwashed .... do.	24 to 28	24 to 28	24 to 28	24 to 28	24 to 28
CINCINNATI.					
Flour:					
Family and fancy ... bbl.	6 60 to 8 00	6 75 to 8 00	6 75 to 8 00	7 00 to 8 25	9 40 to 10 25
Extra .... do..	6 10 to 6 35	6 25 to 6 50	6 25 to 6 50	6 40 to 6 75	8 50 to 8 85
Superfine .... do..	5 60 to 5 90	5 25 to 5 65	5 40 to 5 75	5 75 to 6 00	7 50 to 8 00
Wheat:					
Red winter .... bush.	1 40	1 40 to 1 45	1 50 to 1 55	1 48 to 1 65	1 90 to 2 00
Hill (amber) winter . do..	1 47 to 1 50	1 45 to 1 50	1 55 to 1 60	1 65 to 1 68	2 10 to 2 15
White winter .... do..	1 50	1 55 to 1 58	1 55 to 1 60	1 65 to 1 68	2 10 to 2 15
Oats .... do..	36 to 38	38 to 45	42 to 44	41 to 43	52 to 55
Corn .... do..	48	41 to 44	39 to 45	36 to 38	53 to 58
Rye .... do..	77 to 80	75 to 80	70 to 77	70 to 75	95 to 1 00
Barley .... do..	65 to 1 40	60 to 1 10	55 to 1 03	60 to 1 00	65 to 1 00
Hay:					
Baled, No. 1 .... ton..	11 00 to 13 00	9 00 to 10 00	9 50 to 10 50	11 00 to 12 00	11 00 to 12 00
Lower grades .... do..	8 00 to 10 00	7 00 to 8 00	7 00 to 8 50	8 00 to 10 00	8 00 to 10 00
Pork, mess .... bbl.	17 50 to 17 75	17 00 to 17 25	15 25 to 15 50	15 00	15 50 to 15 75
Lard .... lb.	11 to 12	11 to 12	9¾ to 11	9½ to 10¾	9⅞ to 11

* None in

PRODUCTS IN 1877—Continued.

June.	July.	August.	September.	October.	November.	December.
$0 11 to $0 11⅞	$0 11⅞ to $0 12¼	$0 11⅛ to $0 12⅜	$0 11 to $0 11¼	$0 11½ to $0 12	$0 11⅛ to $0 11¾	$0 11 to $0 11¼
26 to 44	33 to 50	33 to 50	32 to 50	32 to 50	27 to 48	27 to 47
33 to 48	39 to 55	39 to 55	37 to 55	37 to 55	38 to 58	37 to 55
34 to 37	36 to 44	36 to 44	40 to 45	40 to 45	40 to 43	40 to 43
24 to 37	32 to 39	32 to 39	32 to 43	32 to 43	32 to 43	32 to 43
21 to 52	21 to 53	21 to 53	21 to 53	21 to 53	29 to 53	21 to 53
24 to 40	30 to 45	30 to 47	30 to 47	30 to 47	30 to 47	30 to 47
12 to 23	12 to 23	12 to 23	12 to 23	12 to 23	12 to 23	12 to 25
15 to 20	16 to 20	15 to 20	15 to 20	15 to 20	15 to 20	15 to 20
5 75 to 6 50	4 00 to 5 00	4 50 to 5 50	3 75 to 4 50	3 75 to 5 00	3 75 to 4 75	4 00 to 4 75
7 00 to 7 50	6 50 to 7 50	6 25 to 7 00	4 75 to 7 00	5 75 to 7 50	5 25 to 6 50	5 25 to 6 25
7 75 to 10 00	7 50 to 10 50	7 00 to 9 75	7 00 to 8 50	6 50 to 8 75	6 25 to 8 50	6 25 to 8 50
1 80 to 1 95	1 65 to 1 95	1 30 to 1 54	1 10 to 1 40	1 10 to 1 47	1 10 to 1 40	1 20 to 1 45
1 75	1 95 to 2 00	1 55 to 1 58	1 42 to 1 45	1 48 to 1 50	1 40 to 1 47	1 46 to 1 55
....	1 85 to 2 00	1 45 to 1 55	....	....	....	....
75 to 80	75 to 77	65 to 67	58 to 60	67 to 68	65	63 to 65
42 to 50	40 to 48	37 to 46	32 to 36	32 to 38	31 to 37	35 to 39
56 to 62½	56½ to 67	56½ to 67	50 to 60	61 to 71	56 to 62	55 to 64½
15 00 to 19 00	14 00 to 19 00	14 00 to 18 00	14 00 to 17 00	14 00 to 18 00	14 00 to 17 00	14 00 to 17 00
15 50 to 15 75	14 75 to 15 00	15 00 to 15 25	14 30	14 50	15 00	14 25 ....
....	....	....	....	....	....	12 00 ....
10½ to 10¾	9¾ to 10¼	10 to 10¼	9½ to 9¾	10 to 10¼	9½ to 10	9 to 9¼
13 to 18	11 to 17	12 to 20	12 to 20	12 to 23	12 to 23	12 to 22
10 to 23	....	16 to 18	15 to 20	17 to 23	17 to 24	17 to 28
8 to 12½	3 to 9½	3 to 10	6 to 11	11½ to 13	12 to 13	12½ to 12¾
....	8 to 12	8 to 12	9 to 12	12½ to 13½	12⅛ to 13⅛	12 to 13¼
10⅛ to 10⅝	9⅝ to 9⅞	8¾ to 9	8 to 8¼	8⅛ to 8⅝	8 to 8¼	7¼ to 7½
9⅜ to 9⅞	(*)	(*)	(*)	(*)	(*)	(*)
4 to 7½	4 to 7½	4 to 7½	4 to 7½	4 to 7½	4 to 7½	3 to 6
6½ to 9	6½ to 8½	6½ to 8½	6½ to 8½	6½ to 8½	6½ to 8½	5½ to 8
9¾ to 10½	10 to 11⅜	10½ to 11½	.... 10¼	.... 10⅜	10 to 10¼	9¾ to 10¼
10¾ to 11⅛	11⅝ to 12⅞	11⅜ to 12¾	10¾	10⅞ to 11⅝	10⅝ to 11¼	10⅝ to 11¼
35 to 37	33 to 40	36 to 43	32 to 40	32 to 40	33 to 42	33 to 42
28 to 33	30 to 35	36 to 38	33 to 35	33 to 35	35 to 36	35 to 36
23 to 35	....	....	....	....	....	....
24 to 28	24 to 31	28 to 33	25 to 30	25 to 30	25 to 32	25 to 32
8 25 to 9 75	9 00 to 10 00	6 10 to 7 50	5 40 to 6 75	6 00 to 7 50	5 90 to 6 00	5 65 to 6 75
7 75 to 8 00	7 75 to 8 25	5 60 to 5 85	4 85 to 5 10	5 50 to 5 85	5 40 to 5 65	5 25 to 5 40
6 50 to 7 00	6 25 to 7 00	5 00 to 5 25	3 65 to 4 00	4 50 to 5 00	4 50 to 4 85	4 35 to 4 75
1 40 to 1 65	1 70 to 1 90	85 to 1 20	1 15 to 1 18	1 17 to 1 28	1 25 to 1 28	1 20 to 1 27
1 75 to 1 80	1 75 to 1 95	1 25 to 1 30	1 17 to 1 25	1 28 to 1 33	1 28 to 1 35	1 27 to 1 32
....	1 75 to 1 95	1 28 to 1 35	1 17 to 1 25	1 28 to 1 33	1 28 to 1 35	1 27 to 1 35
43 to 46	39 to 43	30 to 40	30 to 35	25 to 30	27 to 31	28 to 31
45 to 50	50 to 52	46 to 49	46½ to 47	47 to 48	34 to 48	39 to 48
75 to 80	62 to 70	50 to 60	55 to 57	60 to 63	58 to 60	61 to 63
40 to 60	45 to 65	Nominal	70 to 75	50 to 63	45 to 70	50 to 75
11 00 to 12 50	11 00 to 12 50	9 00 to 12 00	9 00 to 11 00	10 00 to 11 50	9 00 to 11 00	9 00 to 10 50
7 00 to 9 00	7 00 to 9 00	6 50 to 8 50	6 00 to 8 00	7 00 to 9 00	7 00 to 8 00	7 00 to 8 00
14 50 to 14 75	13 50 to 14 00	14 00	12 25 to 12 50	13 25 to 13 35	13 75 to 14 00	12 00 ....
9 to 10⅝	8½ to 10½	9 to 10¼	8⅛ to 9½	8¼ to 10¼	9 to 9¼	7⅞ ....

market.

MARKET PRICES OF FARM

Products.	January.	February.	March.	April.	May.
CINCINNATI—Continued.					
Butter:					
Choice ....lb.	$0 20 to $0 23	$0 20 to $0 22	$0 21 to $0 23	$0 24 to $0 25	$0 25 to $0 26
Prime ....do.	18 to 19	16 to 18	18 to 20	19 to 21	22 to 23
Cheese, prime to choice factory ....lb.	13½ to 14	13¼ to 14	14½ to 15½	15½ to 16	12 to 12½
Sugar:					
New Orleans, fair to good ....lb.	8¾ to 9¼	9 to 9¾	8¼ to 9¼	9 to 9½	9 to 9¾
New Orleans prime..do.	9¼ to 10	10	9¾ to 10	9¼ to 10	10 to 10¼
Cotton:					
Ordinary to good ordinary ... .lb.	10½ to 11⅛	10⅝ to 11½	10¼ to 10⅞	9⅞ to 10⅜	9 to 9⅝
Low middling to good middling ....lb.	11⅝ to 12⅝	12 to 12¾	11⅜ to 12	10¾ to 11¼	10¼ to 11¼
Wool:					
Fleece-washed ....lb.	30 to 36	30 to 36	30 to 36	30 to 35	30 to 35
Tub-washed ....do.	32 to 38	32 to 38	32 to 38	30 to 36	30 to 36
Unwashed, clothing..do.	21 to 26	21 to 26	21 to 26	21 to 25	21 to 25
Unwashed, combing .do.	37 to 43	37 to 43	37 to 43	27 to 31	27 to 31
Pulled .... do.	27 to 31	27 to 31	27 to 31	27 to 28	27 to 28
CHICAGO.					
Flour:					
Choice winter extras.bbl.	6 75 to 7 50	7 75 to 8 50	7 75 to 8 50	7 50 to 8 00	9 00 to 9 50
Common to good winter extras ....bbl.	5 75 to 6 25	6 00 to 7 50	6 00 to 7 50	6 00 to 7 00	7 75 to 8 75
Spring extras, common to good ....bbl.	5 50 to 5 87½	6 00 to 6 50	6 00 to 6 50	6 00 to 6 25	7 75 to 8 50
Spring extras, choice.do.	6 00 to 6 50	6 50 to 7 00	6 50 to 7 00	6 00 to 6 25	8 75 to 9 50
Patent spring.........do.	6 50 to 8 25	7 25 to 9 50	7 00 to 9 50	6 50 to 8 00	8 50 to 10 75
Spring superfines....do.	3 37½ to 4 50	4 00 to 5 00	4 50 to 5 25	4 00 to 5 00	5 75 to 6 50
Wheat:					
No. 1 spring ....bush.	Nominal	Nominal	Nominal	Nominal	Nominal .....
No. 2 spring ....do..	1 25 to 1 25¾	1 25½ to 1 26½	1 21¾ to 1 23¼	1 28¾ to 1 32	1 54 to 1 58½
No. 3 spring ....do..	1 12 to 1 12¼	1 15 to 1 16	1 13 to 1 14	1 21¾ to 1 23½	1 46 ....
Rye No. 2.............do..	72	70	62 to 63	67 to 67½	85 to 90
Barley No. 2 ....do..	66	60	Nominal	52 to 1 25	80 to 85
Corn No. 2.............do..	44¼ to 45¼	42½ to 42⅞	33¼ to 35⅛	39 to 39¼	51¾ to 53¾
Oats No. 2 ....do..	34 to 34½	35 to 35½	33¼ to 33⅝	31½ to 31½	40¾ to 41¼
Hay:					
Timothy ....ton.	8 50 to 10 00	8 00 to 9 00	7 50 to 8 00	8 00 to 9 50	8 00 to 10 00
Prairie ....do..	7 00 to 7 50	7 00 to 7 50	7 00	7 00 to 7 50	7 00 ....
Beef:					
Mess ....bbl.	10 50 to 10 75	10 75 to 11 00	10 75 to 11 00	11 00	10 78 to 11 00
Extra mess ....do..	11 50 to 11 75	11 75 to 12 00	11 75 to 12 00	11 75 to 12 00	11 75 to 12 00
Pork:					
Mess ....bbl.	16 97½ to 17 00	16 25 to 16 50	14 35 to 14 45	13 90 to 14 00	14 75 to 15 15
Prime mess ....do..	....	14 00 to 14 50	13 00 to 13 35	12 25 to 12 50	13 75 to 14 00
Extra prime.........do..	12 75 to 13 00	11 50 to 11 75	10 00 to 10 25	9 50	10 00 to 10 25
Lard ....cental.	11 05 to 11 45	10 72½ to 10 75	9 50 to 9 55	9 25 to 9 27½	9 60 to 9 80
Butter:					
Choice to fancy ......lb.	27 to 33	27 to 32	25 to 30	24 to 30	23 to 26
Medium to good.....do.	18 to 25	20 to 25	18 to 22	18 to 22	15 to 20
Cheese, good to choice factory ....lb.	13 to 13½	13 to 14	13½ to 14½	15 to 16	14 to 15
Sugar, New Orleans ..do..	9 to 10	8¼ to 9½	8¼ to 9¼	8¾ to 9½	9 to 9½
Wool:					
Tub-washed ....lb.	35 to 42	34 to 40	35 to 42	34 to 42	34 to 42
Fleece-washed.........do.	33 to 36	33 to 37	33 to 37	30 to 38	30 to 38
Unwashed............do.	20 to 26	20 to 26	20 to 26	20 to 27	22 to 25
SAINT LOUIS.					
Flour:					
Winter, common to good, per barrel..............	4 50 to 6 25	4 50 to 6 25	4 50 to 6 25	4 50 to 6 25	5 00 to 7 00
Good to choice......bbl	6 50 to 7 50	7 00 to 8 00	7 00 to 8 00	7 00 to 8 00	7 50 to 9 50
Wheat:					
Red winter, No. 2..bush.	1 37 to 1 38½	1 45 to 1 46	1 44 to 1 45	1 50 to 1 53	2 00 to 2 10
Red winter, No. 3...do..	1 32 to 1 33½	1 35 to 1 36	1 39 to 1 40	1 49 to 1 50	1 94 ....
Red winter, No. 4...do..	1 25 to 1 26	1 32 to 1 33	1 35 to 1 36	1 48	1 84 ....
Oats...................do..	29 to 33	32 to 35	32 to 37	34 to 38	25 to 45
Corn ....do..	37 to 42	35½ to 42	38½ to 42	38 to 40	54 to 56
Rye ....do..	62 to 1 10	76 to 78	62 to 70	62 to 64	70 to 98
Barley, choice ....do..	.... 1 10	.... 1 15	.... 1 15	30 to 1 00	35 to 90
Hay:					
Timothy ....ton.	11 00 to 13 00	11 00 to 13 00	10 00 to 12 00	10 00 to 12 00	11 00 to 13 00
Prairie ....do..	7 00 to 11 00	7 00 to 11 00	7 00 to 11 00	7 00 to 11 00	7 00 to 11 00

PRODUCTS IN 1877—Continued.

June.	July.	August.	September.	October.	November.	December.
$0 20 to $0 24	$0 21 to $0 22	$0 23 to $0 25	$0 25 to $0 26	$0 20 to $0 27	$0 25 to $0 33	$0 21 to $0 32
15 to 20	18 to 20	16 to 18	23 to 24	18 to 25	22 to 25	16 to 21
10½ to 11½	8 to 8½	9 to 9½	11 to 11½	12 to 14	12⅛ to 13½	12¼ to 13
10¼ to 10¾	10½ to 10¾	10¼ to 10½	9¾ to 10	9¾ to 10	9 to 9½	7 to 8
11	11	11	10¼	10¼	....	8 to 8¾
9¼ to 9¾	10⅛ to 11	10⅜ to 10¼	9¼ to 10	10¼ to 10⅛	9⅝ to 10⅛	9⅝ to 10½
10⅜ to 11⅛	11½ to 12	11⅛ to 11¾	10¼ to 11	10¾ to 11⅜	10½ to 11½	10⅝ to 11⅜
28 to 33	30 to 40	30 to 40	30 to 38	35 to 40	35 to 40	35 to 38
30 to 34	33 to 39	33 to 39	33 to 39	33 to 39	33 to 39	33 to 39
21 to 25	21 to 26	21 to 26	21 to 25	22 to 24	22 to 26	22 to 26
27 to 33	27 to 35	27 to 35	27 to 32	28 to 32	28 to 30	28 to 32
27 to 28	....	....	27 to 30	27 to 30	27 to 30	27 to 30
9 25 to 10 25	9 00 to 9 25	8 50 to 9 00	6 50 to 7 00	7 00 to 7 25	7 00 to 7 25	7 00 to 7 25
7 25 to 9 25	6 75 to 8 50	6 50 to 8 00	6 00 to 6 25	6 00 to 6 50	6 00 to 6 50	6 00 to 6 50
8 25 to 8 75	7 75 to 8 25	7 50 to 7 75	5 75 to 7 50	5 50 to 6 00	5 00 to 5 50	5 00 to 5 50
8 75 to 9 25	8 50 to 9 25	8 00 to 8 50	6 25 to 6 75	6 50 to 7 50	5 75 to 6 50	6 75 to 6 50
7 75 to 8 25	8 00 to 9 75	8 50 to 9 75	7 50 to 9 00	7 50 to 8 50	7 00 to 8 00	7 00 to 9 00
4 75 to 5 75	4 25 to 5 25	4 00 to 5 00	....	....	....	3 00 to 3 50
1 63	Nominal	Nominal	1 10	1 18⅛	1 07½ to 1 11	1 07½ to 1 08
1 50⅛ to 1 54	1 41 to 1 48	1 20 to 1 25	1 09½ to 1 11	1 17½	1 05¼ to 1 05¾	1 07¼ to 1 07½
1 39	1 20½	93 to 95	1 05 to 1 05½	1 06	1 02 to 1 02½	1 00½ to 1 00¾
70 to 71	62	56½ to 57	52 to 52½	53½ to 54	54¾ to 55½	52½ to 55¼
Nominal	Nominal	Nominal	67½	60½ to 61	58½ to 59	61½ to 61¾
44¾ to 46	43 to 44	48¼ to 48⅝	42⅛ to 42½	42½ to 42⅝	42 to 43¼	42½ to 42¾
37½ to 37¾	33 to 34	28½ to 29	23¼ to 24⅛	23⅜ to 23⅝	24¼ to 25	24¼ ....
8 00 to 9 50	8 00 to 10 00	7 00 to 8 50	8 00 to 9 00	7 00 to 8 50	8 00 to 9 00	9 00 to 10 50
7 50 to 8 00	7 50	7 50	7 00	5 50 to 6 50	6 50 to 8 00	7 50 to 9 00
10 75 to 11 00	10 75 to 11 00	10 75 to 11 00	10 00 to 10 25	10 00 to 10 25	10 00 to 10 25	9 50 to 10 50
11 75 to 12 00	11 75 to 12 00	11 75 to 12 00	11 00 to 11 25	11 00 to 11 25	11 00 to 11 25	10 50 to 11 00
13 65 to 13 70	12 75 to 12 92½	13 12½ to 13 15	12 20 to 12 30	13 65 to 13 70	13 12½ to 13 50	11 90 ....
12 75 to 13 00	12 00 to 12 25	12 00 to 12 25	11 50 to 12 00	11 75 to 12 00	11 00 to 11 25	11 00 to 11 25
9 00 to 9 25	9 00	9 00 to 9 25	9 00 to 9 75	9 50 to 10 00	9 00 to 9 25	9 75 to 10 00
9 29½ to 9 30	8 55 to 8 62½	8 70 to 8 90	8 26 to 8 32½	8 67½ to 8 70	8 02½ to 8 12½	7 80 to 7 87½
18 to 22	15 to 20	16 to 24	18 to 24	25 to 31	26 to 32	26 to 32
13 to 16	12 to 14	13 to 16	14 to 16	15 to 20	15 to 20	15 to 20
12 to 12½	7 to 8	9 to 10	10½ to 11	12¼ to 13	11½ to 13½	11 to 12
....	....	....	....	....	....	....
30 to 36	35 to 40	36 to 43	36 to 42	36 to 43	36 to 44	36 to 44
30 to 32	30 to 36	36 to 40	36 to 38	36 to 40	37 to 40	35 to 40
18 to 23	20 to 27	23 to 27	25 to 28	22 to 27	25 to 27	22 to 27
6 00 to 9 00	6 00 to 7 00	3 90 to 5 40	2 00 to 5 00	3 00 to 5 00	4 50 to 5 00	4 25 to 5 00
9 00 to 10 50	7 50 to 9 25	6 60 to 7 25	5 20 to 7 25	5 25 to 7 00	5 25 to 6 40	6 25 to 6 50
2 00 to 2 50	1 80 to 1 90	.... 1 30	1 24 to 1 26	1 27½ to 1 30	.... 1 30	....
1 85 to 1 90	1 70 to 1 75	1 20 to 1 23	1 20 to 1 23	1 22	1 25½ to 1 26½	1 21 ....
1 65 to 1 70	1 60 to 1 65	1 10 to 1 14	1 10 to 1 14	....	1 14 to 1 15	1 13 to 1 15
40 to 43	32½ to 36½	27 to 34	26 to 34	23½ to 25¼	23 to 28¼	24½ to 28½
46 to 52	34 to 55	37 to 49½	37 to 58	42 to 46	41¼ to 47	38 to 46½
70 to 98	70 to 98	42 to 58	45 to 58	53 to 57	50 to 55	51 to 53
35 to 90	52 to 60	....	....	80 to 95	45 to 90	50 to 75
11 00 to 13 00	11 00 to 13 00	.... 10 50	.... 10 50	7 50 to 9 00	8 50 to 10 50	10 00 to 12 50
7 00 to 11 00	7 00 to 11 00	....	....	....	....	....

MARKET PRICES OF FARM

Products.	January.	February.	March.	April.	May.
SAINT LOUIS—Continued.					
Beef, mess ....bbl.	$13 50 to $14 00	$13 50 to $14 00	$13 50 to $14 00	$13 50 to $14 00	$13 50 to $14 00
Pork, mess ....do..	..........17 50	17 40 to 17 60	14 75 to 15 00	15 00 to 15 50	16 00 to 16 50
Lard ....do..	9 to 11	9 to 11	9 to 11	9 to 11	9 to 11
Butter:					
Prime to choice dairy .lb.	22 to 28	22 to 28	22 to 28	22 to 28	22 to 28
Country packed prime to choice...........lb.	17 to 20	17 to 20	16 to 18	16 to 18	14 to 16
Cheese:					
Ohio factory ....lb.	12½ to 13½	12½ to 13½	12⅓ to 13½	11⅛ to 12	12½ to 13½
New York factory..do..	13 to 14	13 to 14	13 to 14	13 to 14	13 to 14
Cotton:					
Ordinary to good ordinary ....lb.	9 to 10	10¼ to 11⅞	10 to 11½	10 to 10¾	9¼ to 9¾
low middling to good middling ....lb.	10¾ to 11½	12 to 12⅜	11⅜ to 12¼	11⅛ to 12¼	10½ to 11½
Tobacco:					
Lugs..................lb.	2½ to 5¼	2½ to 5¼	2½ to 5¾	2½ to 5¼	2½ to 5½
common to medium shipping leaf...........lb.	6 to 8	6 to 9	6 to 9	6 to 9	5¾ to 9
Wool:					
Tub-washed..........lb.	33 to 40	33 to 40	30 to 38	30 to 38	32 to 37
Fleece-washed ......do..	....	....	....	....	....
Unwashed ....do..	23 to 26	23 to 26	23 to 26	23 to 26	20 to 26
NEW ORLEANS.					
Flour:					
Superfine ....bbl.	6 20	5 90	5 25 to 5 50	7 00 to 7 25	5 50 ....
Extra ....do..	6 75 to 7 60	6 00 to 7 40	6 00 to 7 50	7 90 to 9 25	6 50 to 7 75
Choice to fancy .....do..	7 00 to 8 50	7 50 to 8 25	7 75 to 8 87½	10 00 to 10 75	8 00 to 9 50
Corn, white and yellow ....bush.	60 to 69	55 to 60	53 to 54	65 to 70	57 to 60
Oats..................do..	48 to 51	45 to 50	47 to 52	47 to 52	48 to 52
Hay:					
Choice..............ton.	....	18 00	18 00	18 00	19 00 ....
Prime .... do..	23 00 to 24 00	14 00 to 15 00	16 50 to 17 00	14 50 to 15 00	17 00 ....
Beef:					
Texas ....bbl.	....	....	....	....	....
Western............do..	13 50 to 15 00	12 25 to 12 50	12 25 to 12 50	14 50 to 15 00	14 50 to 15 00
Fulton market ....½ bbl.	10 50	10 50	10 50	10 50	10 50 to 10 75
Pork, mess............do..	18 25 to 18 50	17 62½ to 18 00	16 00 to 16 25	17 00 to 17 25	15 00 to 15 25
Lard....................lb.	11¼ to 12½	11 to 12	10 to 11¼	10¼ to 11	9½ to 11¼
Butter:					
Choice Goshen ....lb.	32	30 to 31	30 to 33	24 to 27	25 ....
Choice Western ....do..	24 to 25	22	22	18	20 ....
Cheese:					
Choice West'n fact'y..lb.	14½ to 15	13 to 14	15	15 to 15½	13 to 14
New York cream ...do..	16 to 17	16 to 16½	17	16½	16½ ....
Sugar:					
Fair to fully fair .....lb.	7⅝ to 8⅓	8 to 8⅜	8½ to 8¼	8½ to 9¼	9¼ to 9½
Prime to strictly prime, pound	8½ to 8¾	8⅜ to 8¾	8⅜ to 8½	9⅝	9¾ to 9⅞
Clarified, white and yellow ....lb.	9½ to 11	9½ to 11¼	10 to 11¼	10½ to 11½	11 to 12
Cotton:					
Ordinary to good ordinary ....lb.	............11½	11	10⅜ to 10⅞	8¾ to 9½	8¾ to 9⅝
Low middling to good middling..........lb.	11⅞ to 12⅞	11⅜ to 13½	11¼ to 12⅝	10¼ to 11⅝	10⅛ to 11⅝
Tobacco:					
Lugs..................lb.	4½ to 7	4 to 6¼	2 to 6¼	2 to 6¾	2 to 6¼
Low leaf to medium leaf.................lb.	7½ to 10½	7 to 10	7 to 10	7 to 10	7 to 10
Wool:					
Louisiana clear ......lb.	....	....	....	18 to 23	20 to 22
Clear Lake ....do..	....	....	....	22 to 24	24 to 25
SAN FRANCISCO.					
Flour:					
Superfine ....bbl.	5 00 to 5 50	4 75 to 5 00	4 75 to 5 00	4 75 to 5 00	7 00 to 7 50
Extra................do..	5 50 to 6 00	5 25 to 6 25	5 25 to 6 00	5 25 to 6 00	8 75 to 9 00
Family and fancy..,do..	6 25 to 7 25	6 50 to 7 25	6 25 to 7 25	6 25 to 6 72	9 50 to 10 00
Wheat:					
California........cental.	2 00 to 2 25	2 00 to 2 20	2 00 to 2 15	2 00 to 2 20	3 00 to 3 05
Oregon ....do..	2 00 to 2 20	2 00 to 2 20	2 00 to 2 15	2 00 to 2 20	3 00 to 3 05
Barley................do..	1 17½ to 1 30	1 25 to 1 35	1 20 to 1 35	1 50 to 1 60	1 75 to 1 90

PRODUCTS IN 1877—Continued.

June.	July.	August.	September.	October.	November.	December.
$13 50 to $14 00	....	....	....	....	...... $14 25	$13 00 to $13 25
14 50 to 15 00	$13 10 to $13 15	$12 40 to $14 00	$12 40 to $14 00	$13 00 to $13 15	$13 85 to 14 00	12 25 to 12 37½
9 to 11	8¼ to 9½	8¼ to 9½	8½ to 9¼	....	7¾ to 9	7⅝ to 8⅞
22 to 28	20 to 25	20 to 30	15 to 35	14 to 32	22 to 35	20 to 35
14 to 16	7 to 12	9 to 15	10 to 15	8 to 16	10 to 14	15 to 20
....	7 to 9	9 to 9½	9 to 9½	12 to 13	12 to 13½	12 to 14
....	(*)	(*)	(*)	(*)	(*)	(*)
9¼ to 9¾	9¾ to 10¼	....	....	9½ to 10	9½ to 9⅞	9¼ to 10
10½ to 11½	11 to 11¾	....	....	10½ to 11	10¼ to 10¾	10½ to 11⅛
2½ to 5½	....	....	2 to 4½	1⅓ to 4½	1½ to 3	1¾ to 3⅛
5¾ to 9	....	....	4 to 7½	3 to 6¾	2½ to 6½	2½ to 6½
32 to 37	....	28 to 40	28 to 40	28 to 41⅔	28 to 41½	28 to 41½
....	....	....	....	....	....	....
20 to 26	....	20 to 33	20 to 33	25 to 33	27 to 32	20 to 28
.... 5 50	5 25	Nominal	4 50	4 75 to 5 00	.... 5 00	4 25 ....
6 50 to 8 75	6 00 to 7 50	6 00 to 7 75	5 00 to 6 00	5 25 to 6 25	5 25 to 6 75	4 50 to 6 00
9 00 to 9 50	8 50 to 10 50	8 00 to 8 50	6 50 to 7 37½	6 50 to 7 50	6 75 to 7 25	6 00 to 7 00
57 to 60	58 to 60	70 to 79	56 to 67½	57 to 60	56 to 62	60 to 62
48 to 52	46 to 50	40 to 43	40 to 43	41 to 42	36 to 50	37 to 40
19 00	18 00	18 00 to 19 00	17 00 to 17 50	16 00 to 16 50	15 00 to 16 00	18 00 to 19 00
17 00	16 50 to 17 00	17 00	16 00	....	16 50 to 17 00	16 00 ....
13 50 to 14 00	13 00 to 14 00	....	....	....	....	....
14 50 to 15 00	14 50 to 15 00	14 00 to 14 50	14 50 to 15 00	14 50 to 15 00	14 50 to 15 50	12 50 to 15 50
10 50 to 10 75	9 50 to 9 75	9 50 to 9 75	....	....	9 50	9 40 to 9 50
15 00 to 15 75	14 25 to 14 37½	14 25	13 75 to 13 80	14 75 to 15 00	14 75 to 15 00	13 00 to 13 25
9½ to 11¼	9 to 11	9¼ to 11	9¼ to 10	9¾ to 11½	9¾ to 11	8½ to 9¾
25	24 to 27	25 to 30	27 to 30	27 to 28	28 to 30	26 to 31
20	22 to 26	24 to 27	19 to 30	30 to 33	28 to 30	20 to 31
10 to 11	9 to 9½	11½ to 12	10½ to 11	 14	.... 12½	12 to 13
16½	14 to 15	(*)	14	15½ to 16	15	 15
9¼ to 9½	9⅜ to 9¾	9⅝ to 9¾	8¼	8 to 8¼	.... 8⅝	5½ to 6½
9¾ to 9⅞	9⅞	9⅞	8½ to 8¾	8¼ to 8¾	....	6¾ to 7
11 to 12	11 to 12	11 to 12	9½ to 10½	8¾	....	7¼ to 9
8⅛ to 9⅜	9⅝ to 10½	9⅝ to 10⅜	8⅛ to 9¼	9 to 10	9 to 9¾	9 to 9⅞
10⅛ to 11⅝	10⅞ to 12	10⅝ to 11⅝	9⅝ to 10⅝	10⅜ to 11¼	10 to 11⅛	10⅛ to 11½
2 to 6¾	2 to 6¾	.... 6¼	3 to 6	3 to 5¾	3 to 5¼	3 to 5
7 to 10	7 to 10	6⅓ to 10	6¼ to 9	6 to 9	5½ to 8	5¼ to 8
20 to 22	24½ to 25½	26 to 27	....	27 to 28	26½	(*)
24 to 25	27½ to 28	29 to 30	....	28½ to 29	27½ to 29	(*)
6 75 to 7 00	4 75 to 5 00	5 00 to 5 50	4 50	5 00 to 5 25	4 75 to 5 25	4 75 to 5 00
7 25 to 7 50	5 25 to 5 50	5 75 to 6 00	4 75 to 5 00	5 75 to 6 25	5 75 to 6 25	5 75 to 6 25
7 50 to 9 00	5 75 to 6 75	6 50 to 7 50	5 50 to 6 50	6 50 to 7 25	6 50 to 7 25	6 75 to 7 25
2 40 to 2 50	2 15 to 2 25	2 15 to 2 40	1 90 to 2 20	2 00 to 2 37½	2 00 to 2 25	2 15 to 2 45
2 40 to 2 50	2 15 to 2 25	2 15 to 2 40	2 00 to 2 15	2 00 to 2 35	2 00 to 2 30	2 15 to 2 40
1 50 to 1 75	1 50 to 1 75	1 50 to 1 85	1 50 to 1 85	1 60 to 1 85	1 70 to 1 80	1 60 to 1 80

* None in market.

MARKET-PRICES OF FARM

Products.	January.	February.	March.	April.	May.
SAN FRANCISCO—Cont'd.					
Oats .... cental.	$1 85 to $2 00	$1 90 to $2 25	$1 75 to $2 20	$2 00 to $2 25	$2 15 to $2 50
Corn .... do..	1 15 to 1 25	1 20 to 1 30	1 40 to 1 50	1 70 to 1 75	1 95 to 2 05
Hay, State .... ton.	11 00 to 18 00	11 00 to 18 00	10 00 to 15 00	13 50 to 18 50	16 00 to 24 00
Pork:					
Mess .... bbl.	22 00 to 23 00	22 00 to 23 00	22 00 to 23 00	22 00 to 23 00	22 00 to 23 00
Prime mess .... do.	20 00 to 21 00	20 00 to 21 00	20 00 to 21 00	17 50 to 19 00	18 00 to 19 00
Beef:					
Mess .... bbl.	9 00 to 10 25	9 00 to 10 50	9 00 to 10 50	9 00 to 10 50	9 00 to 10 50
Family mess ... half bbl.	8 50	8 50 to 9 00	8 00 tn 8 50	8 00 to 8 50	8 00 to 9 50
Lard .... lb.	13 to 13½	12½ to 14	12½ to 14½	11½ to 14½	11½ to 14½
Butter:					
Overland .... lb.	16 to 18	16 to 18	16 to 18	16 to 18	16 to 18
California .... do.	25 to 35	25 to 35	25 to 28	24 to 26	24 to 28
Oregon .... do.	20 to 25	20 to 25	20 to 25	18 to 20	18 to 20
Cheese .... do.	12½ to 15	12½ to 15	12½ to 15	10 to 15	10 to 15
Wool:					
Native .... lb.	10 to 12	10 to 12	10 to 12	10 to 12	10 to 15
California .... do.	15 to 22	15 to 22	15 to 22	15 to 22	15 to 25
Oregon .... do.	20 to 25	20 to 25	20 to 22	20 to 22	20 to 25

LIVE-STOCK

Products.	January.	February.	March.	April.	May.
NEW YORK.					
Cattle:					
Extra beeves .... cental.	11 25 to 12 50	.... 12 50	....	11 50 to 12 00	.... 12 50
Good to prime ...... do..	10 25 to 11 00	11 25 to 12 00	....	10 50 to 11 25	10 50 to 11 50
Common to fair ..... do..	7 50 to 10 00	8 50 to 11 50	.... 9 25	9 25	9 75 ....
Texans and Cherokees, cental	7 50 to 9 50	.... 8 75	....	8 25 to 8 50	....
Bulk of sales ..... cental.	9 50 to 10 00	....	....	....	....
Average .... do..	9 75	....	....	....	....
Milch cows .... head.	36 00 to 70 00	....	40 00 to 70 00	45 00 to 65 00	50 00 to 70 00
Veal calves ...... cental.	5 00 to 9 00	....	6 50 to 9 50	6 62 to 8 50	5 00 to 7 00
Sheep .... do..	4 50 to 8 00	4 90 to 6 62½	5 12½ to 6 37½	6 50 to 7 50	4 50 to 7 25
Swine .... do..	None alive ...	None alive ...	None alive ...	None alive ...	None alive ..
PHILADELPHIA.					
Cattle:					
Choice beeves .... cental.	6 25 to 7 00	6 25 to 7 00	6 25 to 7 25	5 25 to 7 00	6 25 to 7 00
Fair to good .... do..	5 12½ to 6 12½	5 12½ to 6 12½	5 12½ to 6 12½	5 25 to 6 25	5 25 to 6 00
Common .... do..	4 00 to 5 00	4 00 to 5 00	4 00 to 5 00	4 50 to 5 12½	3 50 to 5 00
Sheep .... do..	1 50 to 7 00	2 00 to 6 50	4 00 to 7 25	5 00 to 7 00	4 00 to 7 50
Swine, corn-fed .... do..	8 50 to 9 25	8 00 to 10 00	8 75 to 9 50	7 00 to 8 50	7 75 to 8 75
BALTIMORE.					
Cattle:					
Best beeves .... cental.	5 50 to 6 25	5 25 to 6 25	5 25 to 6 25	5 37 to 6 25	5 50 to 6 25
First quality .... do..	4 25 to 5 25	4 25 to 5 25	4 50 to 5 25	5 00 to 5 37	5 00 to 5 50
Medium or good quality, cental	3 50 to 4 00	3 50 to 4 00	3 75 to 4 50	4 00 to 5 00	4 50 to 5 00
Ordinary .... cental.	3 00 to 3 50	3 00 to 3 50	3 25 to 3 75	3 50 to 4 00	3 50 to 4 25
General average of the market .... cental.	4 12	4 25	4 50	4 87	5 00 ....
Most of the sale .... do..	3 62 to 4 50	4 00 to 4 75	4 00 to 5 00	4 25 to 5 50	4 75 to 5 50
Sheep .... do..	4 50 to 5 00	4 50 to 7 00	4 50 to 7 00	4 00 to 6 75	4 50 to 6 50
Swine .... do..	8 00 to 8 75	8 00 to 8 62½	7 00 to 8 50	7 00 to 8 00	7 25 to 8 00
CINCINNATI.					
Cattle:					
Good to choice native steers .... cental.	4 00 to 5 00	4 25 to 5 25	4 25 to 5 00	4 25 to 5 25	4 75 to 5 50
Fair to medium ...... do..	3 00 to 3 75	3 25 to 4 00	3 00 to 3 75	3 25 to 4 00	3 75 to 4 50
Common .... do..	2 25 to 2 75	2 25 to 3 00	2 25 to 2 75	2 25 to 3 00	3 00 to 3 50
Sheep .... do..	4 25 to 5 50	3 25 to 5 75	3 25 to 5 75	4 25 to 6 00	3 25 to 6 00
Swine .... do..	6 10 to 7 00	4 90 to 5 90	4 75 to 5 80	4 25 to 5 40	4 50 to 5 50
CHICAGO.					
Cattle:					
Choice beeves ... cental.	5 00 to 5 50	5 25 to 5 75	5 10 to 5 75	5 35 to 5 75	5 75 to 6 00
Good beeves .... do..	4 50 to 4 80	4 30 to 4 75	4 50 to 4 80	4 75 to 5 10	5 25 to 5 50
Medium grades ..... do..	3 80 to 4 40	3 75 to 4 20	4 00 to 4 30	4 30 to 4 60	5 00 to 5 25

PRODUCTS IN 1877—Continued.

June.	July.	August.	September.	October.	November.	December.
$1 90 to $2 25	$1 85 to $2 15	$1 90 to $2 30	$1 75 to $2 00	$1 75 to $2 15	$1 75 to $2 05	$1 60 to $2 10
1 85 to 1 90	1 65 to 1 80	1 85 to 1 90	1 85 to 1 95	1 75 to 1 90	1 60 to 1 75	1 70 to 2 00
14 00 to 23 00	15 00 to 24 00	13 00 to 21 50	13 00 to 22 50	14 00 to 22 50	13 00 to 22 50	13 00 to 22 50
22 00 to 23 00	22 00 to 22 50	22 00 to 22 50	22 00 to 22 50	22 00 to 22 50	22 00 to 22 50	22 00 to 23 50
18 00 to 19 00	18 00 to 19 00	18 00 to 19 00	18 00 to 18 50	18 50 to 19 00	18 00 to 18 50	18 50 to 19 00
9 00 to 10 50	9 00 to 10 50	9 00 to 10 50	9 00 to 9 50	8 50 to 9 00	8 50 to 10 50	8 50 to 10 00
8 00 to 8 50	8 00 to 8 50	8 00 to 8 50	8 00 to 8 50	8 00 to 8 50	8 00 to 8 50	8 00 to 8 50
11½ to 14½	11½ to 13½	11½ to 13½	11 to 13½	11 to 12½	10½ to 12	10½ to 12
18 to 25	18 to 25	18 to 25	18 to 25	18 to 25	18 to 25	18 to 25
24 to 28	24 to 28	24 to 35	24 to 40	25 to 50	25 to 50	25 to 40
18 to 20	18 to 20	18 to 20	18 to 20	18 to 20	18 to 20	18 to 20
10 to 15	10 to 15	10 to 15	10 to 15	10 to 15	12 to 15	15 to 20
10 to 15	12 to 15	12 to 15	11 to 15	10 to 15	10 to 15	10 to 15
15 to 27½	15 to 32	15 to 22	15 to 30	15 to 26	15 to 20	15 to 20
20 to 27½	20 to 33	25 to 33	25 to 30	25 to 26	18 to 20	18 to 20

MARKETS.

12 00 to 12 50	12 75 to 13 00	13 50 to 14 50	12 25 to 12 75	11 50 to 11 75	.... 10 75	11 25 to 11 50
11 00 to 11 75	.... 12 50	13 00 to 13 50	.... 12 00	.... 11 50	9 00	10 00 to 11 00
10 00 to 10 75	7 50	12 00 to 12 25	9 25	8 25	8 00 to 8 75	9 25 to 9 75
....	7 50 to 9 50	11 00	8 25 to 10 25	....	7 00 to 7 25	8 00 to 9 50
....	....	....	....	....	....	9 00 to 10 00
....	....	....	....	....	....	9 50 ....
65 00 to 75 00	40 00 to 80 00	55 00 to 85 00	40 00 to 75 00	40 00 to 80 00	40 00 to 80 00	....
5 00 to 7 25	3 50 to 6 50	3 00 to 7 00	6 25 to 8 25	6 50 to 8 50	2 75 to 8 75	3 00 to 9 00
4 25 to 7 00	4 50 to 6 25	4 75 to 6 25	4 00 to 6 00	4 50 to 5 75	3 30 to 6 12½	4 00 to 6 00
5 70 to 5 81¼	5 40 to 5 60	Scarce and nominal.	5 50 to 5 87½	5 62½ to 6 00	5 40 to 5 56¼	4 70 to 5 20
7 00 to 7 25	7 50	7 25 to 7 75	7 00 to 7 25	6 62½ to 6 75	6 50 to 6 75	6 25 to 6 75
5 50 to 6 75	6 12½ to 7 25	6 00 to 7 00	5 75 to 6 25	5 25 to 6 25	5 25 to 6 25	4 87½ to 5 87½
4 50 to 5 25	3 25 to 6 00	4 50 to 5 75	3 50 to 5 50	4 00 to 5 00	4 00 to 5 00	3 50 ....
4 00 to 5 50	4 00 to 5 75	4 00 to 5 75	4 00 to 6 00	4 00 to 5 75	3 75 to 5 50	3 75 to 5 50
6 50 to 7 75	.... 7 50	.... 7 50	7 25 to 8 00	8 25 to 8 75	8 25 to 8 50	6 00 to 6 75
6 25 to 6 50	6 12 to 6 75	5 75 to 6 70	5 75 to 6 25	5 75 to 6 25	5 12 to 6 00	5 25 to 6 00
5 50 to 6 25	5 00 to 6 00	5 00 to 5 75	4 50 to 5 25	4 75 to 5 25	4 12 to 4 62	4 25 to 5 25
5 00 to 5 50	4 50 to 5 00	4 00 to 4 75	3 25 to 4 25	4 00 to 4 25	3 25 to 4 12	3 90 to 4 25
4 00 to 5 00	3 00 to 4 25	3 50 to 4 00	2 50 to 3 25	3 00 to 3 75	2 00 to 3 00	3 00 to 3 50
5 75	5 62	....	....	....	....	....
5 50 to 6 25	5 00 to 6 25	4 50 to 5 50	3 75 to 4 50	4 00 to 5 00	3 75 to 4 50	3 50 to 4 75
3 75 to 5 25	4 00 to 5 00	4 00 to 5 50	4 00 to 5 00	.... 5 00	1 25 to 5 00	3 50 to 5 00
6 50 to 7 50	6 25 to 7 25	7 75 to 8 75	7 00 to 7 50	7 00 to 8 00	6 50 to 7 50	5 50 to 6 25
4 50 to 5 50	4 25 to 5 75	4 50 to 6 00	4 25 to 5 50	3 75 to 5 25	3 50 to 5 00	3 50 to 4 75
3 25 to 4 25	3 25 to 4 00	3 25 to 4 25	3 25 to 4 00	2 75 to 3 50	2 75 to 3 25	2 75 to 3 50
2 50 to 3 00	2 50 to 3 00	2 50 to 3 00	2 00 to 3 00	2 00 to 2 50	2 00 to 2 50	2 00 to 2 50
3 25 to 4 50	2 50 to 4 00	2 50 to 4 25	2 50 to 4 50	2 50 to 4 50	2 50 to 4 25	2 50 to 4 00
4 25 to 5 20	4 25 to 4 90	4 25 to 5 30	4 50 to 5 35	4 50 to 5 60	4 00 to 4 90	3 90 to 4 50
5 75 to 6 00	6 25 to 6 60	6 00 to 6 25	5 60 to 6 00	5 00 to 5 75	4 60 to 5 00	5 25 to 5 50
5 50 to 5 65	5 60 to 6 00	5 50 to 5 75	5 15 to 5 40	4 25 to 4 75	4 00 to 4 40	4 65 to 5 10
4 75 to 5 50	4 25 to 5 50	4 00 to 5 25	3 25 to 4 60	3 50 to 4 00	3 50 to 3 90	4 10 to 4 50

LIVE-STOCK

Products.	January.	February.	March.	April.	May.
CHICAGO—Continued.					
Cattle—Continued.					
Inferior natives..cental.	$2 00 to $3 50	$2 00 to $3 60	$2 25 to $3 65	$2 25 to $5 25	$2 50 to $4 80
Texans, through droves, cental	....	....	....	....	....
Sheep..............cental.	3 00 to 4 50	3 50 to 5 25	2 75 to 5 50	3 25 to 5 75	4 00 to 6 25
Swine................do..	6 05 to 6 75	5 75 to 6 25	5 40 to 6 00	4 65 to 5 45	4 00 to 5 80
SAINT LOUIS.					
Cattle:					
Good to choice native steers ....cental.	4 50 to 5 25	4 50 to 5 25	4 50 to 5 25	5 50 to 5 75	5 75 to 6 00
Common to fair natives ....cental.	3 25 to 4 25	3 25 to 4 25	3 25 to 4 25	4 75 to 5 25	3 50 to 5 00
Inferior to common natives ....cental.	2 00 to 3 50	2 00 to 3 50	2 00 to 3 25	2 50 to 3 75	2 50 to 4 00
Texans, fair to ch'ce.do..	3 00 to 4 00	3 00 to 4 00	3 00 to 4 00	3 00 to 4 00	3 00 to 4 25
Sheep.................do..	2 75 to 5 00	2 75 to 5 00	2 75 to 5 00	....	2 00 to 6 00
Swine.................do..	4 00 to 6 25	3 75 to 5 90	3 75 to 6 00	....	3 00 to 5 35
Horses:					
Plugs..............head.	30 00 to 65 00	30 00 to 65 00	30 00 to 65 00	30 00 to 65 00	30 00 to 65 00
Plain to choice Southern ....head.	50 00 to 90 00	50 00 to 90 00	50 00 to 90 00	50 00 to 90 00	50 00 to 90 00
Street-car, heavy ...do..	75 00 to 125 00	75 00 to 100 00	75 00 to 100 00	75 00 to 100 00	75 00 to 100 00
Good to extra dr'ght.do..	100 00 to 130 00	100 00 to 130 00	100 00 to 130 00	100 00 to 130 00	100 00 to 130 00
Good drivers ....do..	175 00 to 225 00	150 00 to 175 00	150 00 to 175 00	150 00 to 175 00	150 00 to 175 00
Extra ....do..	225 00 to 250 00	175 00 to 200 00	175 00 to 200 00	175 00 to 200 00	175 00 to 200 00
Auction horses and ponies ....head.	25 00 to 45 00	25 00 to 45 00	25 00 to 45 00	25 00 to 45 00	25 00 to 45 00
Mules:					
14 to 15 hands high.head.	85 00 to 120 00	85 00 to 120 00	85 00 to 120 00	85 00 to 120 00	85 00 to 120 00
15 to 16 hands high..do..	115 00 to 150 00	115 00 to 150 00	115 00 to 150 00	115 00 to 150 00	115 00 to 150 00
Extra ....do..	175 00 to 180 00	175 00 to 185 00	175 00 to 180 00	175 00 to 185 00	175 00 to 185 00
NEW ORLEANS.					
Cattle:					
Tex'n be'ves, ch'ce.head.	35 00 to 45 00	35 00 to 45 00	35 00 to 45 00	35 00 to 45 00	35 00 to 45 00
First quality .....do..	..........35 00	..........35 00	..........35 00	..........35 00	..........35 00
Second quality ...do..	25 00 to 30 00	25 00 to 30 00	25 00 to 30 00	25 00 to 30 00	25 00 to 30 00
Corn-fed beeves..cental.	....	....	....	....	....
Milch-cows ....head.	50 00 to 90 00	50 00 to 90 00	50 00 to 90 00	50 00 to 90 00	50 00 to 90 00
Veal calves..........do..	7 00 to 9 00	7 00 to 9 00	7 00 to 9 00	7 00 to 9 00	7 00 to 9 00
Sheep ....do..	2 00 to 6 00	2 00 to 6 00	2 00 to 6 00	2 00 to 6 00	2 00 to 6 00
Swine ....cental.	5 50 to 9 50	5 00 to 6 00	5 00 to 6 00	5 00 to 6 00	5 00 to 6 00
Horses:					
Good combined ...head.	150 00 to 200 00	150 00 to 200 00	150 00 to 200 00	150 00 to 200 00	150 00 to 200 00
Good plugs ....do..	100 00 to 150 00	100 00 to 150 00	100 00 to 150 00	100 00 to 150 00	100 00 to 150 00
Common ....do..	40 00 to 80 00	40 00 to 80 00	40 00 to 80 00	40 00 to 80 00	40 00 to 80 00
Mules:*					
First class, broken.head.	190 00 to 225 00	190 00 to 225 00	190 00 to 225 00	190 00 to 225 00	190 00 to 225 00
Good, suited to sugar-making ....head.	175 00 to 200 00	175 00 to 200 00	175 00 to 200 00	175 00 to 200 00	175 00 to 200 00
Small, suited to rice and cotton planters, broken..........head.	100 00 to 105 00	100 00 to 105 00	100 00 to 105 00	100 00 to 105 00	100 00 to 105 00

* Green mules generally sell about $10

MARKETS—Continued.

June.	July.	August.	September.	October.	November.	December.
$2 50 to $4 25	$2 50 to $5 00	$2 25 to $4 50	$2 00 to $3 00	$2 00 to $3 40	$2 60 to $3 15	$2 50 to $3 90
....	....	....	....	2 50 to 3 50	2 50 to 3 50	2 40 to 3 25
2 75 to 5 00	2 50 to 4 50	3 00 to 4 40	3 00 to 4 25	2 75 to 4 50	3 00 to 4 25	2 75 to 4 00
4 90 to 5 25	4 60 to 4 90	4 50 to 5 15	4 70 to 5 40	4 75 to 5 90	4 50 to 4 90	4 20 to 4 45
5 00 to 5 50	............6 50	5 65 to 6 35	4 85 to 5 50	4 50 to 5 37½	4 50 to 5 35	4 25 to 5 00
3 50 to 4 50	............4 00	............5 25	............4 40	3 00 to 4 00	3 12½ to 4 25	............3 75
2 50 to 4 00	2 75..........	3 00..........	2 75..........	2 75 to 3 00	2 85 to 3 10	....
3 00 to 4 25	....	2 85 to 3 75	2 80 to 3 65	2 65 to 3 60	2 85 to 4 25	2 75 to 4 15
2 30 to 6 00	2 75 to 4 25	2 25 to 4 50	2 75 to 4 50	2 75 to 4 50	2 00 to 4 35	2 00 to 4 35
3 25 to 5 35	4 00 to 4 55	6 05 to 6 40	5 85 to 6 35	5 70 to 6 20	4 85 to 5 65	3 60 to 4 40
30 00 to 65 00	....	20 00 to 40 00	20 00 to 40 00	20 00 to 40 00	20 00 to 40 00	15 00 to 30 00
50 00 to 90 00	....	60 00 to 85 00	50 00 to 75 00	40 00 to 80 00	40 00 to 80 00	35 00 to 70 00
75 00 to 100 00	....	90 00 to 110 00	80 00 to 100 00	80 00 to 100 00	75 00 to 90 00	70 00 to 85 00
100 00 to 130 00	....	90 00 to 160 00	90 00 to 160 00	90 00 to 175 00	90 00 to 175 00	100 00 to 160 00
150 00 to 175 00	....	110 00 to 175 00	110 00 to 200 00	150 00 to 160 00	150 00 to 160 00	140 00 to 160 00
175 00 to 200 00	....	175 00 to 250 00	200 00 to 250 00	200 00 to 250 00	250 00 to 300 00	250 00 to 300 00
25 00 to 45 00	....	25 00 to 45 00	25 00 to 40 00	25 00 to 40 00	25 00 to 40 00	25 00 to 40 00
85 00 to 120 00	....	70 00 to 95 00	70 00 to 95 00	50 00 to 85 00	50 00 to 85 00	50 00 to 85 00
115 00 to 150 00	....	90 00 to 140 00	90 00 to 140 00	85 00 to 150 00	85 00 to 125 00	85 00 to 125 00
175 00 to 185 00	....	140 00 to 160 00	140 00 to 160 00	150 00 to 165 00	135 00 to 160 00	135 00 to 160 00
35 00 to 45 00	35 00 to 45 00	40 00..........	40 00..........	40 00..........	40 00..........	....
............35 00	............35 00	30 00 to 35 00	30 00 to 35 00	30 00 to 35 00	30 00 to 35 00	30 00 to 35 00
25 00 to 30 00	25 00 to 30 00	25 00 to 30 00	25 00 to 30 00	25 00 to 30 00	25 00 to 30 00	20 00 to 30 00
2 50 to 4 00	....	....	....	2 50 to 4 00	2 50 to 4 00	2 50 to 5 00
50 00 to 90 00	50 00 to 90 00	50 00 to 80 00	40 00 to 70 00	40 00 to 80 00	50 00 to 100 00	50 00 to 100 00
7 00 to 9 00	7 00 to 9 00	8 00 to 10 00	6 00 to 8 00	6 00 to 8 00	6 00 to 8 00	6 00 to 10 00
2 00 to 6 00	2 00 to 6 00	2 00 to 5 00	2 00 to 5 00	2 00 to 5 00	2 00 to 5 00	2 00 to 4 00
5 00 to 6 00	5 00 to 6 00	5 50 to 6 00	4 00 to 6 00	4 00 to 6 50	4 50 to 6 00	3 50 to 5 00
150 00 to 200 00	150 00 to 200 00	150 00 to 200 00	150 00 to 200 00	150 00 to 200 00	135 00 to 185 00	135 00 to 185 00
100 00 to 150 00	100 00 to 150 00	100 00 to 150 00	100 00 to 150 00	100 00 to 150 00	85 00 to 135 00	85 00 to 135 00
40 00 to 80 00	40 00 to 80 00	40 00 to 80 00	40 00 to 80 00	40 00 to 80 00	25 00 to 65 00	25 00 to 65 00
190 00 to 225 00	190 00 to 225 00	190 00 to 225 00	190 00 to 225 00	190 00 to 225 00	175 00 to 210 00	175 00 to 210 00
175 00 to 200 00	175 00 to 200 00	175 00 to 200 00	175 00 to 200 00	175 00 to 200 00	160 00 to 185 00	160 00 to 185 00
100 00 to 105 00	100 00 to 105 00	100 00 to 105 00	100 00 to 105 00	100 00 to 105 00	85 00 to 90 00	85 00 to 90 00

per head lower than broken ones.

LIVE-STOCK MARKETS.

NEW YORK.

The annual receipts of different classes of farm animals during the last ten years were as follows:

Animals.	1868.	1869.	1870.	1871.	1872.
Beeves	293, 101	325, 761	356, 026	380, 934	425, 275
Cows	5, 382	4, 836	5, 050	4, 646	5, 089
Calves	82, 935	93, 984	116, 457	121, 937	115, 130
Sheep	1, 400, 623	1, 479, 563	1, 463, 878	1, 331, 975	1, 179, 518
Swine	976, 511	901, 308	899, 625	1, 334, 492	1, 922, 777
Total	2, 758, 552	2, 805, 452	2, 841, 036	3, 173, 984	3, 647, 789

Animals.	1873.	1874.	1875.	1876.	1877.
Beeves	442, 744	454, 033	453, 060	477, 276	505, 217
Cows	4, 701	3, 676	5, 034	3, 967	4, 110
Calves	116, 015	104, 719	117, 580	125, 594	130, 161
Sheep	1, 206, 715	1, 165, 353	1, 228, 530	1, 247, 820	199, 067
Swine	1, 985, 389	1, 774, 228	1, 388, 541	1, 282, 171	1, 286, 004
Total	3, 755, 564	3, 502, 009	3, 192, 745	3, 136, 828	3, 124, 559

BOSTON.

The following table shows the receipts, for the last ten years, of cattle, calves, sheep, fat hogs, and pigs:

Year.	Cattle.	Veals.	Sheep.	Fat hogs.	Pigs.	Total.
1868	110, 018	13, 700	492, 736	127, 544	10, 443	754, 441
1869	129, 353	13, 000	440, 404	145, 200	23, 816	751, 873
1870	124, 592	16, 000	450, 997	168, 902	20, 529	781, 020
1871	129, 147	13, 230	467, 065	338, 020	13, 280	960, 742
1872	157, 366	17, 852	412, 217	592, 727	9, 298	1, 189, 460
1873	167, 730	19, 358	414, 026	838, 203	16, 304	1, 455, 621
1874	163, 300	17, 670	364, 281	561, 937	26, 324	1, 133, 512
1875	145, 285	16, 781	372, 370	317, 938	14, 051	866, 425
1876	158, 989	13, 027	348, 510	352, 202	9, 115	881, 843
1877	155, 907	15, 981	346, 647	325, 776	4, 834	849, 145

BALTIMORE.

CATTLE.—The annual receipts of cattle at Baltimore during the last eleven calendar years were as follows: 1867, 55,713 head; 1868, 75,801; 1869, 91,000; 1870, 89,021; 1871, 88,386; 1872, 92,292; 1873, 94,664; 1874, 130,946; 1875, 113,379; 1876, 109,854; 1877, 112,862. Of the receipts of 1877 the butchers of Baltimore, Washington, Annapolis, and other neighboring towns took 78,000; stock-breeders of Maryland and Pennsylvania took 21,600, and Eastern speculators 13,350 head.

Swine.—The receipts of swine for eight years were as follows: 1870, 300,000; 1871, 307,436; 1872, 400,874; 1873, 392,734; 1874, 357,547; 1875, 277,496; 1876, 247,462; 1877, 322,945. The entire receipts were taken by butchers of the city and vicinity. The abundance of ice increased the number of hogs packed during the summer; winter packing has been entirely neglected for many years.

CINCINNATI.

CATTLE.—The receipts and shipments of all grades, together with the annual average prices per cental of prime beeves during the last twenty commercial years, were as shown in the table below. Statistics of this market are gathered by the Cincinnati Merchants' Exchange, and arranged in "commercial years," ending August 31 of each calendar year.

Commercial years.	Receipts.	Shipments.	Average prices of prime beeves.	Commercial years.	Receipts.	Shipments.	Average prices of prime beeves.
1857–'58	29, 566	17, 115	$3 78	1867–'68	87, 459	43, 315	$7 27
1858–'59	43, 100	23, 615	4 88	1868–'69	107, 813	40, 185	5 62½
1859–'60	43, 182	20, 593	3 90	1869–'70	107, 167	54, 681	5 85
1860–'61	40, 585	19, 357	3 30	1870–'71	125, 771	53, 278	5 05
1861–'62	37, 004	23, 467	3 24	1871–'72	169, 855	76, 866	4 73¼
1862–'63	31, 915	16, 739	3 96	1872–'73	149, 629	53, 385	4 99⅜
1863–'64	39, 152	14, 903	5 74	1873–'74	199, 426	79, 551	3 90
1864–'65	54, 424	19, 070	7 45	1874–'75	227, 450	103, 438	4 30. 7
1865–'66	79, 503	31, 300	7 55	1875–'76	243, 503	98, 322	3 95. 6
1866–'67	91, 496	43, 079	7 27½	1876–'77	202, 726	98, 800	3 50. 8

SHEEP.—The receipts and shipments of the last twenty commercial years were as follows:

Year.	Receipts.	Shipments.	Year.	Receipts.	Shipments.	Year.	Receipts.	Shipments.
1857–'58	17, 869	4, 363	1864–'65	47, 023	5, 815	1871–'72	187, 522	68, 541
1858–'59	29, 064	6, 025	1865–'66	72, 229	13, 177	1872–'73	131, 633	62, 755
1859–'60	25, 069	6, 724	1866–'67	91, 987	24, 052	1873–'74	240, 161	101, 975
1860–'61	22, 041	6, 000	1867–'68	73, 097	19, 809	1874–'75	278, 102	172, 007
1861–'62	27, 453	7, 433	1868–'69	117, 548	31, 353	1875–'76	355, 848	278, 320
1862–'63	25, 900	4, 745	1869–'70	90, 205	35, 581	1876–'77	246, 188	210, 220
1863–'64	35, 223	4, 077	1870–'71	134, 892	51, 109			

SWINE.—The number, weight, lard product, and value of the hogs packed during the last seven winter packing seasons at Cincinnati were as follows:

Season.	Number packed.	Average gross weight per head.	Aggregate gross weight.	Average yield of lard per head.	Aggregate yield of lard.	Average cost per cental.	Aggregate cost of hogs packed.
		Pounds.	*Pounds.*	*Pounds.*	*Pounds.*		
1870–'71	481, 560	298. 8	143, 890, 128	42. 62	20, 524, 087	....	....
1871–'72	630, 301	289. 2	182, 283, 049	41. 02	25, 854, 947	$4 36. 4	$7, 949, 362
1872–'73	626, 305	304. 9	190, 960, 394	45. 67	28, 603, 349	3 92. 3	7, 491, 276
1873–'74	581, 253	280. 7	163, 232, 506	39. 7	23, 074, 744	4 58. 2	7, 341, 953
1874–'75	560, 164	278. 25	155, 864, 126	41. 77	23, 398, 050	6 99. 17	10, 897, 584
1875–'76	563, 359	273. 68	154, 185, 385	37. 8	21, 296, 034	7 27. 53	11, 217, 469
1876–'77	523, 576	274. 71	143, 834, 281	38. 2	20, 000, 665	5 90. 18	8, 488, 237

CHICAGO.

HORSES.—The receipts and shipments of the last five years were as follows:

Months.	1873.		1874.		1875.		1876.		1877.	
	Receipts.	Shipments.	Receipts.	Shipments.	Receipts.	Shipments.	Receipts.	Shipments.	Receipts.	Shipments.
January	627	467	688	604	483	562	152	200	151	171
February	2,135	1,978	2,538	2,376	1,222	1,441	726	617	859	646
March	4,253	3,909	3,838	3,690	2,784	2,781	1,607	1,522	1,775	1,516
April	2,913	2,801	2,739	2,672	2,083	1,835	1,230	1,224	1,110	900
May	2,666	2,663	1,603	1,607	1,376	1,407	930	828	853	802
June	2,737	2,276	1,807	1,508	1,150	1,096	790	696	762	633
July	1,104	984	804	839	648	715	445	440	458	308
August	1,073	1,002	853	760	416	414	464	299	350	324
September	1,340	1,254	838	888	431	424	953	381	440	241
October	779	609	1,251	1,223	293	323	497	373	397	338
November	422	370	423	256	271	260	244	156	390	278
December	240	227	206	185	172	151	121	108	325	182
Total	20,289	18,540	17,588	16,608	11,329	11,109	8,159	6,839	7,874	6,439

CATTLE.—The following table shows the receipts and shipments of cattle during the first seven years of the current decade:

Months.	1871.		1872.		1873.		1874.	
	Receipts.	Shipments.	Receipts.	Shipments.	Receipts.	Shipments.	Receipts.	Shipments.
January	30,708	16,639	44,990	33,047	50,520	30,564	59,438	44,771
February	43,299	28,782	41,087	36,146	45,019	35,509	52,775	43,719
March	44,752	39,578	53,705	43,170	63,836	56,477	72,542	59,935
April	48,144	43,522	58,393	52,474	84,249	68,531	77,346	66,733
May	50,217	49,455	71,700	67,039	81,602	80,261	77,373	72,993
June	52,564	44,637	63,449	52,335	85,380	68,818	89,274	68,728
July	50,041	39,754	58,439	41,928	73,207	54,505	65,118	48,299
August	50,583	36,007	64,463	47,211	67,731	49,726	73,308	50,541
September	53,175	38,528	66,744	43,179	65,394	44,301	73,761	45,854
October	37,981	22,759	64,957	34,388	63,845	34,162	85,193	50,161
November	42,781	20,378	55,884	32,468	37,712	23,351	65,530	37,643
December	29,805	21,393	40,799	26,105	42,933	27,976	52,308	38,552
Total	543,050	401,432	684,610	509,490	761,428	574,181	843,966	627,929

Months.	1875.		1876.		1877.	
	Receipts.	Shipments.	Receipts.	Shipments.	Receipts.	Shipments.
January	64,951	43,694	71,062	45,771	96,318	54,651
February	58,142	44,113	79,938	56,835	94,598	61,994
March	80,149	65,314	100,972	78,115	103,518	85,102
April	92,374	82,888	97,796	88,717	93,410	81,070
May	80,736	72,170	115,140	97,301	93,869	75,299
June	90,481	70,384	92,739	74,972	78,046	55,415
July	65,471	52,624	89,765	70,644	64,012	40,053
August	85,948	61,924	90,176	65,279	82,711	51,070
September	82,495	55,294	101,816	73,308	96,073	60,466
October	84,763	62,301	88,604	54,244	91,842	54,153
November	72,003	42,462	90,646	52,737	74,407	41,510
December	63,330	43,342	78,091	40,001	64,051	38,300
Total	920,843	696,534	1,096,745	797,724	1,032,855	699,083

SHEEP.—The receipts and shipments of seven years were as follows:

Months.	1871.		1872.		1873.		1874.	
	Receipts.	Shipments.	Receipts.	Shipments.	Receipts.	Shipments.	Receipts.	Shipments.
January	35, 111	17, 576	42, 069	23, 235	39, 751	20, 787	29, 173	15, 621
February	43, 608	25, 512	41, 803	25, 348	27, 729	24, 728	41, 586	27, 545
March	42, 213	29, 321	38, 170	29, 495	31, 061	23, 020	34, 866	26, 630
April	23, 379	13, 084	24, 771	17, 328	75, 570	12, 798	26, 100	19, 233
May	23, 337	8, 557	16, 389	5, 945	21, 030	8, 653	20, 218	11, 319
June	22, 667	6, 496	13, 776	3, 493	20, 262	5, 506	17, 538	5, 501
July	19, 022	5, 214	13, 819	2, 471	17, 697	784	16, 035	2, 991
August	25, 471	6, 917	18, 777	3, 937	19, 921	1, 152	21, 926	6, 879
September	27, 732	7, 264	22, 452	5, 622	16, 794	1, 975	23, 268	8, 768
October	18, 632	4, 397	48, 290	7, 349	27, 871	5, 472	30, 837	11, 657
November	19, 144	3, 697	24, 343	7, 417	18, 506	4, 566	30, 765	14, 229
December	15, 737	7, 029	25, 552	13, 376	17, 042	5, 794	46, 353	32, 182
Total	316, 053	135, 004	330, 211	145, 016	333, 234	115, 235	338, 655	180, 555

Months.	1875.		1876.		1877.	
	Receipts.	Shipments.	Receipts.	Shipments.	Receipts.	Shipments.
January	58, 162	41, 898	50, 249	33, 803	43, 586	23, 667
February	42, 571	27, 924	45, 201	30, 607	37, 399	24, 396
March	50, 985	36, 702	39, 334	27, 295	32, 935	25, 132
April	41, 952	30, 359	29, 386	20, 491	28, 286	19, 895
May	16, 476	6, 008	17, 745	9, 839	19, 582	7, 109
June	16, 639	3, 228	15, 956	5, 252	14, 216	3, 877
July	12, 626	982	13, 874	2, 821	10, 782	581
August	24, 386	9, 371	19, 051	5, 204	19, 788	7, 288
September	28, 286	9, 346	25, 946	10, 889	21, 986	6, 716
October	31, 916	16, 721	36, 341	18, 305	26, 995	10, 658
November	40, 667	20, 488	33, 673	15, 449	28, 701	12, 235
December	54, 282	37, 579	37, 339	15, 970	26, 484	11, 354
Total	418, 948	240, 604	364, 095	195, 925	310, 740	152, 908

SWINE.—The monthly receipts and shipments of swine will be found in the following table:

Months.	1871.		1872.		1873.		1874.	
	Receipts.	Shipments.	Receipts.	Shipments.	Receipts.	Shipments.	Receipts.	Shipments.
January	300, 697	26, 530	361, 935	78, 377	561, 245	95, 237	487, 088	146, 435
February	139, 342	47, 724	268, 236	104, 668	378, 760	163, 140	303, 341	163, 980
March	97, 058	75, 387	170, 785	144, 209	271, 626	224, 194	238, 728	202, 317
April	71, 632	63, 086	169, 149	145, 151	292, 903	225, 715	311, 945	245, 945
May	137, 521	111, 524	265, 259	196, 451	261, 361	217, 914	328, 838	265, 140
June	197, 499	166, 513	254, 714	206, 940	245, 860	189, 586	310, 072	238, 396
July	165, 831	134, 391	212, 030	172, 934	244, 550	201, 682	231, 416	183, 450
August	118, 975	98, 187	219, 406	198, 077	234, 145	188, 776	205, 904	147, 355
September	164, 749	125, 561	214, 728	186, 010	239, 512	191, 241	261, 123	168, 628
October	161, 212	131, 370	229, 304	175, 241	325, 716	196, 569	350, 812	242, 350
November	386, 766	113, 643	373, 563	132, 381	616, 301	156, 926	727, 407	203, 437
December	456, 831	67, 490	513, 114	95, 195	665, 771	146, 577	531, 705	119, 928
Total	2, 398, 113	1, 161, 406	3, 252, 623	1, 835, 634	4, 337, 750	2, 197, 557	4, 258, 379	2, 327, 361

Months.	1875.		1876.		1877.	
	Receipts.	Shipments.	Receipts.	Shipments.	Receipts.	Shipments.
January	508,347	135,509	446,061	48,294	359,695	46,473
February	421,833	127,532	360,444	74,959	243,932	79,020
March	240,797	147,778	211,389	105,756	255,381	109,487
April	259,569	171,505	226,602	94,026	316,816	101,593
May	272,887	164,090	307,250	127,890	272,304	78,602
June	299,051	165,184	369,581	125,188	321,492	82,442
July	290,137	157,781	261,564	125,529	255,584	85,060
August	190,788	111,378	224,006	111,736	242,431	96,236
September	165,919	119,181	278,999	106,833	242,538	87,112
October	301,255	135,073	392,946	100,800	334,657	79,843
November	491,393	94,428	569,195	71,218	499,800	48,834
December	470,134	53,204	541,969	39,406	681,970	58,150
Total	3,912,110	1,582,643	4,190,006	1,131,635	4,026,600	952,912

PORK-PACKING.

IN THE WEST.

The following statistics are compiled from the annual records kept by the Cincinnati Price Current.

WINTER PACKING.—*Numbers packed.*—The number of hogs packed during the last twenty-nine winter-packing seasons, with the prices per cental, net and gross, were as follows:

Seasons.	Number packed.	Cost per cental.	Cost per cental.	Seasons.	Number packed.	Cost per cental.	Cost per cental.
		Net.	*Gross.*			*Net.*	*Gross.*
1849–'50	1,652,220	$2 66	$2 13	1864–'65	2,422,779	$14 32	$11 46
1850–'51	1,332,867	3 75	3 00	1865–'66	1,785,955	11 67	9 34
1851–'52	1,182,846	4 45	3 56	1866–'67	2,490,791	7 22	5 78
1852–'53	2,201,110	6 01	4 81	1867–'68	2,781,084	7 95	6 36
1853–'54	2,534,770	4 19	3 35	1868–'69	2,499,873	10 22	8 18
1854–'55	2,124,404	4 21	3 37	1869–'70	2,635,312	11 53	9 22
1855–'56	2,489,502	5 75	4 60	1870–'71	3,695,251	6 58	5 26
1856–'57	1,818,468	5 94	4 75	1871–'72	4,831,558	5 15	4 12
1857–'58	2,210,778	4 86	3 89	1872–'73	5,410,314	4 66	3 73
1858–'59	2,465,552	6 28	5 02	1873–'74	5,466,200	5 43	4 34
1859–'60	2,350,822	5 91	4 73	1874–'75	5,566,226	8 33	6 66
1860–'61	2,155,702	5 67	4 57	1875–'76	4,880,135	8 82	7 05
1861–'62	2,893,666	3 03	2 42	1876–'77	5,101,308	7 18	5 74
1862–'63	4,069,520	4 20	3 36	1877–'78	6,505,446	4 99	3 99
1863–'64	3,261,105	6 70	5 36				

The total number packed during the twenty-nine seasons is 90,815,564, averaging $6.46 per cental net, or $5.17 gross. Omitting the six exceptional seasons from 1865 to 1870, the average for the remaining twenty-three is $5.42 net, or $4.34 gross.

Weights and yields of lard.—The aggregate and average net weights and yields of lard during the last thirteen seasons, with average and aggregate cost, were as follows:

Seasons.	Average annual net weight per head.	Aggregate annual net weight.	Average yield of lard per head.	Aggregate yield of lard.	Average cost per cental, net.	Aggregate cost of hogs packed.
	Pounds.	*Pounds.*	*Pounds.*	*Pounds.*		
1865-'66	231 30	413, 091, 391	41 52	74, 152, 851	$11 67	$48, 947, 518
1866-'67	232 14	588, 212, 222	39 66	98, 801, 376	7 22	42, 468, 922
1867-'68	201 00	558, 997, 884	29 00	80, 651, 436	7 95	44, 440, 332
1868-'69	206 75	516, 848, 742	32 33	80, 829, 227	10 22	63, 055, 047
1869-'70	205 75	542, 215, 444	31 84	83, 908, 334	10 53	77, 958, 963
1870-'71	230 14	850, 425, 065	40 19	148, 512, 137	6 58	55, 957, 969
1871-'72	227 62	1, 099, 783, 385	38 54	188, 603, 317	5 15	56, 638, 344
1872-'73	232 43	1, 257, 519, 283	40 08	216, 845, 385	4 66	58, 600, 399
1873-'74	214 97	1, 175, 126, 971	35 02	191, 444, 035	5 43	62, 809, 394
1874-'75	209 77	1, 167, 639, 457	34 20	190, 380, 607	8 33	97, 264, 367
1875-'76	217 71	1, 062, 456, 021	35 45	173, 016, 580	8 82	93, 709, 621
1876-'77	215 92	1, 101, 478, 090	34 08	173, 877, 890	7 18	79, 086, 127
1877-'78	226 04	1, 470, 506, 963	38 61	251, 193, 500	4 99	62, 338, 827

Distribution of numbers.—The following table shows the numbers packed in the different States of the West and Northwest during the last six winter packing seasons:

States.	1872-'73.	1873-'74.	1874-'75.	1875-'76.	1876-'77.	1877-'78.
Ohio	885, 827	906, 804	870, 971	819, 602	813, 709	934, 132
Indiana	610, 966	715, 703	666, 575	574, 433	530, 286	496, 025
Illinois	1, 834, 611	1, 887, 328	2, 113, 845	1, 915, 830	1, 905, 219	2, 714, 748
Iowa	325, 417	369, 278	426, 258	361, 746	419, 442	486, 850
Missouri	894, 334	746, 366	707, 310	556, 143	644, 699	804, 614
Kansas	40, 885	64, 037	49, 536	30, 725	31, 775	41, 470
Nebraska	20, 220	29, 085	26, 950	26, 190	46, 190	56, 000
Minnesota	24, 550	32, 700	20, 950	18, 750	24, 235	23, 700
Wisconsin	324, 072	333, 514	269, 468	217, 426	266, 861	412, 614
Michigan	49, 306	71, 549	62, 836	53, 837	88, 689	120, 095
Kentucky	322, 456	257, 259	308, 068	263, 748	255, 986	318, 201
Tennessee	39, 300	26, 577	22, 639	22, 818	50, 770	66, 897
Miscellaneous*	28, 450	26, 000	20, 820	17, 887	23, 447	30, 000
Total	5, 400, 394	5, 466, 200	5, 566, 226	4, 880, 135	5, 101, 308	6, 505, 446
Increase		65, 806	100, 026		221, 173	1, 404, 138
Decrease				686, 091		

* Including several points outside of the above States.

Net weight.—The average net weights per head of hogs packed in the different States of the West and Northwest during the last six winter packing seasons were as follows:

States.	1872-'73.	1873-'74.	1874-'75.	1875-'76.	1876-'77.	1877-'78.
	Pounds.	*Pounds.*	*Pounds.*	*Pounds.*	*Pounds.*	*Pounds.*
Ohio	242. 51	233. 49	222. 73	215. 14	218. 15	223. 85
Indiana	230. 25	207. 22	208. 80	210. 41	199. 41	214. 32
Illinois	239. 21	219. 02	213. 76	231. 46	218. 09	229. 57
Iowa	229. 55	204. 67	198. 67	215. 81	207. 75	220. 53
Missouri	214. 12	207. 01	189. 74	215. 85	213. 93	219. 74
Kansas	244. 18	220. 64	171. 63	232. 03	240. 41	267. 48
Nebraska	246. 71	214. 65	193. 36	218. 57	220. 39	232. 28
Minnesota	227. 27	229. 36	237. 46	248. 63	249. 94	261. 10
Wisconsin	230. 45	210. 89	212. 48	215. 80	226. 67	236. 51
Michigan	237. 94	234. 02	234. 27	229. 70	232. 35	234. 88
Kentucky	225. 84	213. 87	209. 60	215. 92	222. 52	223. 72
Tennessee	207. 11	200. 42	192. 39	214. 81	208. 04	208. 65
Miscellaneous	237. 94	207. 94	197. 08	220. 92	213. 70	215. 33
General average	232. 43	214. 97	209. 77	217. 71	215. 92	226. 04

The average weight per head increased during the last winter season 10.12 pounds, or nearly 5 per cent., and was greater than in any one of the four preceding seasons.

Cost.—The average cost per cental of hogs packed during the last six winter seasons was as follows:

States.	1872-'73.	1873-'74.	1874-'75.	1875-'76.	1876-'77.	1877-'78.
Ohio	$4 82.59	$5 57.24	$8 64.30	$8 96.00	$7 20	$5 15
Indiana	4 43.96	5 29.63	8 14.96	8 81.00	7 02	4 93
Illinois	4 67.10	5 43.25	8 35.60	8 93.00	7 42	5 10
Iowa	4 31.29	5 19.03	7 87.58	8 24.00	6 82	4 48
Missouri	4 63.30	5 36.63	8 19.10	8 70.00	7 05	4 82
Kansas	4 01.10	4 77.58	7 59.00	7 66.00	6 61	4 36
Wisconsin	4 72.48	5 72.16	8 56.04	8 76.00	7 11	4 83
Minnesota	4 81.00	5 68.52	7 28.90	7 72.00	6 49	4 42
Nebraska	3 70.00	4 64.17	7 22.00	7 79.00	6 78	4 40
Kentucky	4 88.00	5 44.45	8 67.51	9 05.00	6 99	5 35
Tennessee	5 13.50	5 72.23	8 81.00	8 29.00	6 74	5 03
Michigan	4 94.20	5 54.30	8 15.88	8 66.00	6 92	4 83
Miscellaneous	4 94.20	5 58.10	8 64.00	8 92.00	7 16	5 31
General average	4 65.80	5 43.15	8 33.63	8 82.00	7 18	4 99

Packing in the principal cities.—Over 70 per cent. of the hogs packed in the West last season were packed at six leading points, Chicago, Cincinnati, Saint Louis, Milwaukee, Louisville, and Indianapolis. The following table shows the number packed at each of these points during the last twenty-five winter seasons:

Season.	Chicago.	Cincinnati.	Saint Louis.	Milwaukee.	Louisville.	Indianapolis.	Total for these cities.	Per cent. of the whole packing.
1853-'54	52,849	421,000	90,000	43,000	407,033	44,900	1,058,782	41.77
1854-'55	73,694	355,786	89,830	34,000	238,788	34,476	826,844	38.92
1855-'56	80,380	405,396	96,700	34,000	332,733	65,030	1,014,239	40.72
1856-'57	74,000	344,512	71,531	15,000	245,830	27,160	778,033	42.78
1857-'58	99,262	446,667	98,000	16,000	253,803	40,880	954,612	43.18
1858-'59	171,684	382,826	57,500	32,000	288,590	33,217	965,817	39.17
1859-'60	151,339	434,499	70,326	52,000	251,870	32,276	792,310	33.70
1860-'61	271,805	433,799	79,800	51,000	198,751	38,781	1,073,936	49,87
1861-'62	505,691	474,467	84,093	94,761	91,335	42,100	1,292,447	44.66
1862-'63	970,264	608,457	175,000	182,465	116,000	77,000	2,129,186	52.32
1863-'64	904,659	370,623	240,099	141,091	103,267	66,400	1,826,139	56,00
1864-'65	760,514	350,600	185,894	107,130	92,409	55,888	1,552,435	64.07
1865-'66	507,355	354,079	116,760	87,853	90,519	36,000	1,192,546	66.78
1866-'67	639,332	462,610	176,800	133,370	157,071	53,739	1,622,922	65.56
1867-'68	796,226	366,831	237,323	159,463	140,980	52,645	1,753,468	63.05
1868-'69	597,954	356,555	224,341	129,094	167,209	56,466	1,531,619	61.27
1869-'70	688,140	337,330	241,316	172,626	182,000	55,474	1,675,886	63.21
1870-'71	918,087	500,066	305,600	241,000	242,135	105,000	2,311,888	62.56
1871-'72	1,218,858	630,301	419,032	315,000	309,512	172,100	3,064,803	63.43
1872-'73	1,425,079	626,305	538,000	303,500	302,246	196,317	3,391,447	62.68
1873-'74	1,520,024	581,253	463,793	294,054	226,947	295,766	3,381,837	61.87
1874-'75	1,690,348	560,164	462,246	236,596	273,118	278,339	3,500,811	61.79
1875-'76	1,592,065	563,359	329,895	181,972	223,147	323,184	3,213,825	65,85
1876-'77	1,618,084	523,576	414,747	225,598	214,862	294,198	3,291,065	64.51
1877-'78	2,501,285	632,302	509,540	371,982	279,414	270,150	4,564,673	70.16

The average net weights per head of the hogs packed at these cities during the last four winter seasons were as follows:

Cities.	1874-'75.	1875-'76.	1876-'77.	1877-'78.
	Pounds.	*Pounds.*	*Pounds.*	*Pounds.*
Chicago	212.42	217.32	215.97	228.37
Cincinnati	220.60	218.95	219.77	227.25
Saint Louis	192.00	214.78	206.42	216.02
Milwaukee	196.00	201.00	221.73	232.64
Louisville	209.27	215.15	221.12	222.89
Indianapolis	208.56	209.83	182.50	195.43
General average of the cities	209.47	215.13	213.11	224.95
General average at other points	210.27	222.69	221.38	228.72
General average of the whole	209.77	217.71	215.98	226.04

The average yield of lard per head at these cities during the last four winter seasons were as follows:

Cities.	1874-'75.	1875-'76.	1876-'77.	1877-'78.
Chicago	37.30	36.32	35.10	39.60
Cincinnati	41.77	37.80	38.20	40.96
Saint Louis	30.00	36.56	32.55	38.20
Milwaukee	29.50	31.00	30.25	39.81
Louisville	29.87	32.04	32.62	34.83
Indianapolis	31.15	30.63	26.50	32.05
General average of the cities	35.43	35.47	34.00	38.91
General average of the interior points	32.21	35.41	34.08	37.91
General average of the whole	34.20	35.43	34.03	38.61

SUMMER PACKING.—The number of hogs packed in the West during the last four summer seasons were as follows:

Packing points.	1874.	1875.	1876.	1877.
Chicago	446,368	728,781	1,315,402	1,508,026
Cincinnati	136,153	118,783	121,173	134,416
Saint Louis	150,962	102,424	131,158	148,277
Milwaukee	12,600	2,632	60,827	54,785
Louisville	....	....	9,500	19,800
Indianapolis	204,426	89,162	283,621	204,264
Total from six cities	950,509	1,041,782	1,921,681	2,069,568
Cleveland	117,136	106,304	187,392	146,048
Cedar Rapids	73,839	72,133	105,580	110,130
Des Moines	....	....	28,609	34,503
Keokuk	....	....	....	16,000
Waterloo, Iowa	....	....	6,750	15,000
Kansas City	16,000	....	66,754	77,821
Detroit, Mich	10,000	9,000	24,000	34,028
Other interior points	38,920	33,124	17,100	40,022
Total interior points	249,895	220,561	436,185	473,552
Grand total	1,200,404	1,262,343	2,357,866	2,543,120

The weight and yield of lard of hogs packed during the last four summer seasons in the West were as follows:

Season.	Average net weight.	Aggregate net weight.	Average yield of lard per head.	Aggregate yield of lard.
	Pounds.	*Pounds.*	*Pounds.*	*Pounds.*
1874	164. 00	196, 872, 810	....	....
1875	177. 32	223, 845, 720	29. 25	36, 923, 533
1876	184. 10	424, 879, 300	30. 35	70, 040, 980
1877	190. 57	484, 653, 471	33. 56	85, 364, 176

WINTER AND SUMMER PACKING IN THE WEST.—The results of the winter and summer packing of the last six packing years (including summer and winter seasons) may be summarized as in the following table:

Packing years.	Number of hogs packed.			Net weight.		Yield of lard.	
	Summer.	Winter.	Total.	Average per head.	Aggregate.	Average per head.	Aggregate.
				Pounds.	*Pounds.*	*Pounds.*	*Pounds.*
1872-'73	505, 500	5, 410, 314	5, 915, 814	228. 80	1, 353, 564, 283	39. 25	232, 212, 585
1873-'74	1, 062, 916	5, 466, 200	6, 529, 116	209. 78	1, 369, 640, 599	34. 09	222, 566, 195
1874-'75	1, 200, 444	5, 566, 226	6, 766, 670	201. 65	1, 364, 512, 267	32. 82	221, 880, 256
1875-'76	1, 262, 343	4, 880, 135	6, 142, 478	209. 41	1, 286, 301, 741	34. 00	208, 831, 900
1876-'77	2, 357, 866	5, 101, 308	7, 409, 174	206. 01	1, 526, 357, 390	32. 79	243, 918, 870
1877-'78	2, 543, 120	6, 505, 446	9, 048, 566	216. 07	1, 955, 160, 434	37. 19	336, 557, 676

The above table shows a growing aggregate of pork production in late years, with increasing weight and lard product.

IN THE EAST.

SEABOARD CITIES.—*Summer and winter packing:*

Cities.	1876-'77.				1877-'78.			
	Summer.		Winter.		Summer.		Winter.	
	Live.	Dressed.	Live.	Dressed.	Live.	Dressed.	Live.	Dressed.
Boston	233, 562	6, 688	126, 762	66, 433	213, 634	9, 565	141, 933	27, 907
New York	757, 144	7, 222	469, 042	65, 880	774, 157	17, 785	636, 127	38, 229
Philadelphia	201, 600	18, 400	95, 840	31, 340	210, 750	22, 400	93, 600	37, 250
Baltimore	175, 631	5, 000	88, 445	20, 000	196, 107	5, 000	128, 916	25, 000
Total	1, 369, 937	37, 310	780, 089	183, 653	1, 394, 648	54, 750	1, 000, 962	128, 386

Albany and Troy.—The number of hogs packed at these two cities during the last four winter seasons were as follows:

November 1 to March 1—	Albany.	Troy.	Total.
1874-'75	55, 315	25, 000	80, 315
1875-'76	44, 238	22, 500	66, 738
1876-'77	30, 000	15, 000	45, 000
1877-'78	40, 000	15, 000	55, 000

Buffalo.—The receipts and shipments of hogs during the last two packing years were as follows:

	1876–'77.	1877–'78.
Receipts	1,082,900	1,264,530
Shipments	886,600	1,044,930
Excess of receipts	196,300	219,600

ON THE PACIFIC SLOPE.

	1874.	1875.	1876.	1877.
San Francisco	230,000	90,000	175,000	135,000
Interior points	160,000	80,000	55,000	85,000
Total	390,000	170,000	230,000	220,000
Add for Oregon	60,000	65,000	75,000	90,000
Total Pacific slope	450,000	135,000	305,000	310,000

IN CANADA.

The returns of the Cincinnati Price Current show an aggregate of 151,781 hogs packed in Canada the last winter season, against 186,198 in the winter of 1876–'77, and 119,989 in the winter of 1875–'76. During the summer season of 1877 the packing embraced 12,957 head, against 58,544 in 1876. The total number packed during the twelve months ending March 1, 1878, was 164,738, against 244,742 during the year ending March 1, 1877. Of the number packed during the last winter season 21,000 were packed in the province of Quebec, and the residue in the province of Ontario. The largest packing at any one point was at Toronto, which disposed of 26,000 head. An unusually large number were packed by farmers and by small operators in villages and towns, owing to the decline in the price of hogs. The proportion of bacon is greater and that of barreled pork less than in former years. The average yield of lard per head was 19.20 pounds, against 18.34 the previous winter season. The amount of barreled pork was 23,000 barrels, a falling off of 7,000 barrels from the product of the previous packing season.

RECAPITULATION.

The total number of hogs packed in all sections of the country during the last three packing years will be found in the following table:

Sections.	Summer.	Winter.	Total.
1875–'76.			
The West	1,262,343	4,880,135	6,142,478
Buffalo, Albany, and Troy	88,324	126,738	215,062
Pacific slope	170,000	85,000	255,000
Canada	40,000	119,989	159,989
From Atlantic cities	1,509,531	887,391	2,396,922
Grand total	3,070,198	6,099,253	9,169,451
Increase over preceding season			
Increase per cent			

Recapitulation—Continued.

Sections.	Summer.	Winter.	Total.
1876–'77.			
The West	2,307,866	5,101,308	7,409,174
Buffalo, Albany, and Troy	82,800	101,450	184,250
Pacific slope	200,000	105,000	305,000
Canada	58,544	186,198	244,742
From Atlantic cities	1,405,247	963,742	2,368,989
Grand total	4,054,457	6,457,698	10,512,155
Increase over preceding season	984,259	358,445	1,342,704
Increase per cent	32	6	15
1877–'78.			
The West	2,543,120	6,505,446	9,048,566
Buffalo, Albany, and Troy	76,425	123,505	199,930
Pacific slope	200,000	110,000	310,000
Canada	12,957	151,781	164,738
From Atlantic cities	1,449,393	1,128,962	2,578,355
Grand total	4,281,895	8,019,694	12,301,589
Increase over preceding season	227,438	1,561,996	1,789,434
Increase per cent	5	24	17

The usual demand has been maintained for statistical statements from the records of the office, and for specific investigation, from Congress, agricultural and commercial organizations, and individual publicists and other investigators. The deprivation of an adequate printing appropriation has prevented publication of current work of statistical collection and compilation, and disappointed applicants for local details of crop reports and current national and international statistics.

J. R. DODGE,
Statistician.

Hon. W. G. LE DUC,
Commissioner.

MAIZE AND SORGHUM AS SUGAR PLANTS.

PREFATORY REMARKS BY THE COMMISSIONER.

Upon assuming the duties of Commissioner of Agriculture, July 1, 1877, I found the sugar industry—one of the most important of our national interests connected with agriculture—in a greatly depressed condition.

The sugar crops of Louisiana which, before the late civil war, had been fluctuating for a series of years, had reached a point where the yield, in comparison to the demand, was extremely insignificant; and my attention was at once directed to the discovery of some means by which the supply might be made to at least equal the average production of former years.

Circulars were, therefore, addressed to the most prominent sugar-grow-

ers of the South, inquiring into the causes of failure and asking for correct information as to the status of the industry there, with the expressed desire upon my part of imparting in return whatever aid and information this department could legitimately give to stimulate the planters in the sugar territory along the Gulf coast to a combined effort to bring up the business to a more prosperous condition.

The responses to these inquiries revealed no lack of zeal or intelligent interest on the part of the planters themselves; and facts were elicited which went far to show that, by concerted action (under a more stable condition of society than has been possible in that region during the past few years), by the proper utilization of all the old approved facilities for production, by the abolition of a baleful system of unnecessary waste, and by the timely application of such new improvements as the mechanical and chemical science of the day would supply, aided by such fostering care on the part of the government as is due to so important an interest, we might reasonably hope that the former condition of the business would ultimately not only be attained, but outstripped; and that, from this source alone we might, after some years of earnest effort, free ourselves from the present condition of vassalage to foreign nations, to whom we now pay so large a tribute annually (in round numbers, one hundred million dollars) for our sugar. Still there were many circumstances tending to retard the rapid advance of the Southern sugar production, circumstances which could be modified or removed only after the lapse of considerable time, resulting as they did from the sudden change in the labor system of the country, by the substitution of free for slave work, and from the lack of the necessary capital to equip and improve existing sugar estates, or to reclaim those abandoned plantations which, during and since the war, were ruined by inundation from broken levees. Moreover, at no time had our Southern sugar lands produced more than a fractional part of the annual demands of the United States, and under no condition of prosperity to which the business could *speedily* attain, even supposing the government should by any and all means stimulate the industry, was it probable that the disproportion between the production and the steadily increasing demand would be diminished as rapidly as could be desired.

Thus it became, in the outset, an important duty to consider whether all the possible resources of the country for the production of sugar had been exhausted, or whether there might not remain some new or comparatively untried methods by which our home supply could be largely augmented. The belief and expectation of many that the *beet* would be made to yield in this country, as in France and Germany, sugar of good quality, in sufficient abundance, and at a sufficiently low cost to take the place eventually of the imported sugars produced from the tropical cane, had not been realized; although no pains had been spared to insure success, and large sums had been expended by capitalists in the equipment of factories, &c., at different points in the country, notably at Chatsworth, Ill., in Sauk County, Wisconsin, and in California. In these cases, as in all others of which I had knowledge, disappointment had been the invariable result, notwithstanding advantage had been taken of the most approved apparatus and processes of manufacture, of the importation of skilled workmen, of the introduction of a system of culture adapted to the proper growth of the beet as understood in Europe, and of the information disseminated both in the publications of this department and in all the prominent agricultural and scientific journals of the country.

While it would thus seem that we cannot reasonably hope to find in beet-culture a sure compensation for diminished cane-sugar crops, the

subject is yet of sufficient importance to merit further consideration. The examinations which have been in progess in this department will therefore be extended over another year, in the hope that some additional information may be imparted through the translation of recent French publications, and from the examination of European methods by the agent of the department, Dr. McMurtrie, who is charged with the superintendence of the exhibit of American agricultural products in Paris, and who is instructed to avail himself while there of any and all information in regard to the beet-sugar industry of European states. Something, too, may remain to be learned in this connection of our Canadian neighbors, who claim to have attained to a higher success than ourselves in this industry—a success which is the less to be wondered at when the fact is made known that the local legislature of that country so well understood the importance of the matter, as far back as 1873, as to pass a law at that time offering $25,000 as a premium to the first successful manufactory of beet sugar in the province, and afterward, in 1875, to increase the premium to $7,000 annually for ten years, or a total of $70,000. Who can say that success in our own country would not have been greater under a like stimulus?

Aware of the large annual drain from the country—the $100,000,000 of which I have spoken—for foreign sugars, of the discouraging condition of the cane-sugar interest at the South, of the failure of all attempts to supplement the deficiency of cane with beet sugar; impressed with these facts, and seeking a remedy, if one there be, I chanced to be in attendance at the State fair in Minnesota in September, 1877, and was surprised to find there a sample of sugar made in that State equaling in appearance the common brown sugar of Louisiana. This sugar was reported to have been made from a new variety of sorghum, which, from its early ripening quality and the fair color of the sirup, was called the "Minnesota early amber." Further inquiries at the time, and subsequent correspondence with several parties who had grown it and manufactured sirup and sugar from it, elicited statements which I condense as follows:

This cane has come into general use in Rice County, Minnesota, which produced 15,000 gallons of sirup from it last season. It became noted during the past two years from the success of two persons chiefly, Messrs. Kenney and Miller, of Rice County, in crystallizing the juice. The latter of these gentlemen, Mr. C. F. Miller, procured some of the seed in Minnesota in 1873. He sent some of it to a friend living near Saint Louis, Mo., who grew the cane there and returned the seed again to Minnesota. Mr. Miller attributed to the southern grown seed when planted farther north an increased luxuriance of growth and greater yield of sirup over that ripened in Minnesota. More or less sugar has been obtained from this cane since 1875. About one-half of the sirup produced by these men has crystallized the past season to a greater or less extent, and it is estimated by them that one-half the crop can be made to yield sugar.

The "mush sugar," when the crystallization has taken place with regularity, generally occupies from one-third to two-thirds of the space in the barrel or other vessel containing the mingled sugar and sirup. In the growing of this variety it is found that a high clay loam of a rather loose or sandy texture is the best. The application of barn-yard manure is said to dilute and injure the juice. New land is regarded as preferable to old land for the perfection of this variety. No marked peculiarity in the preparation of the soil, planting, or cultivation is to be noted. The ground should be plowed immediately before planting and thoroughly pulverized with the harrow.

In Minnesota the seed is planted about the 15th of May, and either

drilled in rows 4 feet apart, or in hills with 7 to 10 seeds in each, the hills 3 feet 6 to 10 inches each way. The seed should be covered with half an inch of soil if the earth is moist, or one inch if it is dry. The rows should be straight, and as soon as the young plants appear the ground must be stirred close to the cane by working from each side of the row close up to the hills with a hoe, or a planet-wheel hoe may be used to good advantage in doing this work if the ground has been well prepared before planting; or a cultivator may be rigged with a sheet-iron guard (to prevent the loosened earth from being thrown on the hills,) and used at this stage of the work. The ground must be cultivated until the leaves shade the ground sufficiently to prevent the growth of weeds.

There is a difference of opinion as to the proper time of harvesting the crop. Mr. Miller, above mentioned, who has had a large experience in cane-growing, maintains that this cane should be perfectly ripe before being cut, and that the cane that stood the longest uncut the past season made not only the finest quality of sirup and sugar, but a far larger proportion of sirup granulated in the barrels.

Mr. Kenney, who has also grown this variety ever since it was recognized as distinct, has not been as successful in making sugar from ripe cane, but produced his from cane the seed of which was merely in the dough, with some of the seeds partly filled out. With him it did best to lie by four or five days after being cut.

The stripping of the cane is dispensed with as useless. It is asserted that the leaves speedily dry out and do not affect the quality of the juice. Frost is very injurious, the pith turning green when frozen. All broken or damaged canes should be thrown out, as they injure the quality of the sirup. The utmost degree of cleanliness should be observed in the treatment of the juice, and precautions should be taken to avoid fermentation. It is the practice to filter the juice as it passes from the mill through a box packed full of fresh straw, and I would suggest the trial of other filters during the coming season, such as well-washed wool or gravel. This straw or other filter used must be renewed every day, or scrupulously cleaned by scalding, and all wooden vessels should be frequently scalded; not washed with hot water, but scalded with boiling water. Wooden vessels should be avoided if possible and copper ones used. It is stated that the juice is subjected to no chemical treatment, and the process of evaporation does not differ from that commonly pursued in manufacturing the common crude sirup from other varieties of cane, except that the sirup is boiled to a greater density, so as to weigh 13¼ pounds to the gallon of sirup when cold. If the crude juice is allowed to stand over night, it is invariably spoiled. After leaving the evaporator the sirup is cooled by being passed through a long tin pipe to the reservoir, or it is caused to traverse the surface of a shallow flat box with strips of wood shorter than the width of the box nailed to the bottom, and arranged somewhat in the manner of the transverse ledges of the "Cook evaporator," except that the first two or three ledges at the head of the box should extend clear across so as to cause the sirup to flow over instead of around them, and thus arrest behind them any mechanical impurities depositing from the sirup. When the sirup has been cooled it is then barreled and kept in a warm place, and the sugar forms by a slow separation and subsidence to the bottom and by attachment to the sides of the barrel, continuing often until the barrel is half full or more of mush sugar. Drainage from sacks has been tried, but the result was an imperfect separation of the sugar from gum and other impurities. The best sugar was separated by a small centrifugal machine.

The amount of sugar produced from the "early amber cane" is five to

six pounds from a gallon of sirup weighing 13¼ pounds. The yield per acre in Minnesota varies from a hundred and twenty-five to a hundred and fifty gallons of sirup. The centrifugal-drained sugar from this cane made as above is very fair in color, of fine flavor, and almost entirely of the cane-sugar type. A specimen of it analyzed by the chemist of the department, whose report is herewith given, shows it to contain glucose in comparatively an insignificant amount.

The following is the report, and it is published in full that the method of obtaining the results may be known and examined by experts competent to judge, thus setting at rest the quality of sugar that can be made from this species of sorghum:

DEPARTMENT OF AGRICULTURE,
Washington, D. C.

SIR: I have the honor to report that the sample of sugar from the Minnesota early amber sugar-cane, submitted for the purpose, has been analyzed and found to have the following percentage composition:

Cane sugar (saccharose)	88.8934
Grape sugar (glucose)	5.6100
Water (by drying at 110 C.)	5.8250

The estimations of sugar were made by means of Fehling's test liquor. The principle governing the method employed is based upon the fact that glucose has the power to reduce oxide of copper, when in an alkaline solution, to the state of suboxide in such a manner that there is a fixed relation between the amount of copper oxide reduced and that of the glucose employed. Cane sugar of itself does not possess this property, but if to its solution in water about 2 per cent. by volume of strong hydrochloric or sulphuric acid be added, and the whole heated to boiling for about three hours, it will be converted into a mixture known as inverted sugar, consisting of glucose and levulose, which is possessed of the requisite power to reduce copper oxide.

In order to prepare the solution of copper oxide for this purpose we proceed as follows: Dissolve 34.649 grains of pure crystallized sulphate of copper in about 200 cubic centimeters of distilled water; make another solution of 173 grains of pure crystallized potassic sodic tartrate (Rochelle salts) in 480 cubic centimeters of solution of sodic hydrate of 1.14 specific gravity; add the first solution gradually to the second and dilute the mixture to 1,000 cubic centimeters.

In making the estimation in a sample of raw sugar, which contains both glucose and saccharose, we first dissolve 10 grains of the product in sufficient water for the purpose and dilute the solution to 500 cubic centimeters. Take a convenient quantity of the copper solution, say 10 cubic centimeters, heat the solution to gentle boiling and, without interrupting the operation, carefully add a given volume of the sugar solution, say about 15 cubic centimeters, continue the boiling five or ten minutes longer, then allow to cool, collect the precipitate upon a filter, wash thoroughly dry, ignite in a crucible until all the paper is consumed, allow the crucible to cool, moisten the contents with strong nitric acid, and carefully ignite again. By this treatment the suboxide or copper will be oxidized.

Determine the weight of the resulting cupric oxide, and from it estimate the amount of glucose corresponding to it; 100 parts of oxide of copper correspond to 45.855 parts of glucose.

To determine the saccharose, add to 50 cubic centimeters of the sugar solution to be tested about 2½ cubic centimeters of strong hydrochloric or sulphuric acid, and boil the mixture about three hours, adding water as the solution evaporates. Then neutralize the free acid with sodic carbonate and add water, if necessary, to make the volume of the liquid up to 50 cubic centimeters, and add it to a convenient quantity of boiling copper solution as before, being careful in all cases that there shall be a slight excess of the latter.

The subsequent treatment is precisely the same as that given above for the glucose. From the amount of copper oxide found deduct the amount corresponding to the glucose already determined, and the remainder will represent the saccharose. One hundred parts of copper oxide represents 44.864 parts of saccharose. The determination of percentages is now a simple matter of calculation, which it will be useless to describe.

Respectfully submitted.

WM. McMURTRIE,
Chemist.

To Hon. W. G. LE DUC,
Commissioner of Agriculture.

The so-called "Minnesota early amber" cane seems to be a sub-variety possessing characteristics worthy of special notice. Its habit and general appearance indicate a close resemblance to the imphee "Oomseana," from which Mr. C. D. Aldrich, of Morristown, Minn., believes it to be derived, and he thinks that the peculiarities which it exhibits are the result of acclimatization in the Northwest.

Little was known, however, as to the origin of this variety until a recent communication was received by me from Mr. E. Y. Teas, of Dunreith, Ind., who claims to know its early history, and to have first introduced it by the name it now bears, "Early Amber," many years before its peculiarities had become so marked as at present. His statement is as follows:

> In a visit to Europe eighteen years ago, in search of seeds and plants, I bought of Vilmorin, Andrieux & Co., seedsmen in Paris, a few pounds of Chinese cane-seed, asking them for the best variety. This seed was given to a friend to plant who was an experienced grower and manufacturer of sorghum. In this lot of cane one stalk was found of a different habit from the rest, that ripened its seed before the rest of the plot was fully in bloom. Seed of this stalk was saved, and the next year planted separate to prevent admixture. This crop ripened much sooner than any other cane known to me, and the sirup was superior in color and taste to any other produced in the neighborhood. From its earliness and fair color I named it "Early Amber," and under this name sent packages to customers in nearly every State and Territory in the Union, especially to Minnesota and the Western and Southern States. It ripens from 90 to 100 days after the planting, yields 120 to 150 gallons of sirup per acre, and about 6 pounds of sugar per gallon. It may be ripened in August. Means have lately been taken to separate the sugar from the sirup.

While not expecting this new variety of sorghum to exhibit precisely the same qualities under conditions of soil and climate different from those of Minnesota, I yet deemed it worthy of extended experiment, and accordingly procured, during the season of 1877, a sufficient quantity of seed (the purity of which was vouched for), and placed it in the hands of agriculturists in nearly every Congressional district in the United States for trial and more accurate determination of its value. It should be remarked that the parties who have brought this variety into notice on account of its sugar-yielding qualities distinctly disclaim any success whatever in producing sugar from the old-fashioned Chinese cane or any of the imphees, and assert, what is now too well known for controversy, that during the period of more than twenty years which has elapsed since the introduction of sorghum into the United States sugar has never been made, as far as known, in paying quantities from any of the old sorts.

A considerable quantity, in the aggregate, has been reported from year to year to have been made from sorghum; but it is well known that the sirup from this cane has often produced a grape-sugar granulation which no doubt has in some instances been placed erroneously to the credit of the plant as cane sugar. However this may be, an examination of the reports of sugar production in the best sorghum-growing States reveals how meager, at the best, it has been during a period of fifteen consecutive years. In the State of Ohio, for example, the number of pounds of sorghum sugar annually produced and reported scarcely exceeded the number of acres of cane planted.

According to the testimony of his son-in-law, Mr. Edwin Henry, William R. Prince, of Flushing, Long Island, was the first to introduce the Chinese variety of sorghum into the United States. Mr. Henry says: "He imported the black-seed variety from France in 1853. In 1854 it was offered to the public. A very few pounds were disposed of the first year. The following year a large hogshead of seed was disposed of in small quantities." From the recollections of Mr. D. S. Curtis, who

writes under date of October, 1877, I take the following: "About the year 1857, while farming in the State of Wisconsin, I raised a small patch of Chinese sorghum, from which a good sirup was made, but this we failed to make granulate into sugar; but, by extra boiling, we made a pretty fair specimen of candy. In 1858 I succeeded in getting the sirup to granulate, and made a tolerably fair article of brown sugar. I had no regular machines for grinding and expressing the juice, but cut up the canes into small pieces, about half an inch long, with an ax. These were put into coarse grain-bags and boiled in a common wash-boiler, on the stove, over a good fire, for several hours, the water being just sufficient to cover the bags. The juice was now squeezed and pressed out of the bag into a small kettle placed within a larger one containing water, and kept boiling and stirred often, for the greater part of a day, until it became about as thick as molasses candy. Then it was put into a shallow tin pan over a moderate heat, and constantly stirred until it took the appearance of dark New Orleans sugar, or wet sand. And thus we had complete, granulated sugar."

To the best of my knowledge this is the first sorghum sugar ever made in this country. It will be seen that it was made from the Chinese variety of sorghum, and it is notable that success was here attained despite of, and most likely because of, the absence of the ordinary appliances for expressing the juice, and the substitution therefor of the diffusive process. Perhaps to this one fact, more than all other causes, is to be attributed the marked success attending Mr. Curtis' experiment in a direction where failure has been the general rule.

The imphee, or African variety of sorghum, was first introduced into this country, as is well known among readers of agricultural journals and reports, by Mr. Leonard Wray, an Englishman, who arrived in New York in 1857, bringing with him seed of this variety which he had obtained from Natal, South Africa. This gentleman declared that he had seen sugar made from more than one variety of these imphees, and expected to meet with signal success and realize a large fortune in his operations in this country. As a matter of fact, he was entirely unsuccessful in being able to make sugar from the juices of any variety worked here.

In the progress of my inquiries into the means of increasing the production of sugar I accidentally discovered that Mr. F. L. Stewart, a gentleman residing in Western Pennsylvania, had made during the past year some important discoveries connected with the production of sugar from maize and sorghum. After entering into correspondence with him, and making full inquiry as to the extent of his researches and the practical value of his discoveries, I was gratified to find that the field of original research to which he had been applying himself occupied precisely the ground where at this time competent investigation was most needed, and that the conclusions which he had established anticipated the most important inquiries that I had to make. I found that he had made the subject of the chemistry of saccharine juices a specialty for some years past, and that he was about to publish an account of the discovery by him of a process by which sugar, in much larger quantities than has heretofore been supposed to exist in it, can now be made from the juice of the stalks of maize or Indian corn, taken at a period when the grain is only partially matured. His experiments seem to warrant the belief that the yield of sugar from this source may be made, by a careful system of manufacture, to equal, per acre of ground planted, nearly the average of sugar now produced from the sugar-cane in Louisiana, and that the American people could easily render themselves independent of foreign

nations and the caprices of the foreign sugar trade by growing and manufacturing their own sugar at comparatively small cost.

Of equal and perhaps of greater importance is the statement which is made by Mr. Stewart in the most unequivocal terms, that on account of the similarity of the juice of sorghum to that of maize in most important particulars the same process is applicable to both, and that by this means the juice of any of the prominent varieties of sorghum now known to the country may be rapidly and uniformly crystallized, and an amount of sugar may reasonably be expected to be produced from any of them equal to the average product of either the sugar-cane in Louisiana or the sugar-beet in Europe.

Results like these have never been claimed before, and if these claims be established as facts during the coming season, their importance, not only to this country but also to foreign nations, is well worthy of the most careful consideration, and is almost beyond estimate.

Mr. Stewart states that those varieties of sorghum which are well known to have yielded heretofore only a crude table sirup, especially the old Chinese sorghum, are now to be considered as among our most valuable varieties, yielding a sugar not only of the best quality but in the greatest abundance.

Mr. Stewart claims that an intimate practical acquaintance since 1862 with all that has been done to utilize sorghum in this country prepared him for the work upon which he has recently been engaged, and that he had frequently succeeded in crystallizing sugar from this cane before; but that the impediments in the way of the successful adoption of any of the old methods were so numerous and the results at best so uncertain, on account of the continued presence in the juice of peculiar substances which resisted all attempts then made to remove them, as to render abortive every effort to crystallize the sugar in a practical way, although its existence in the juice, in large amounts, was always the result of chemical analysis.

With the view to determine beyond question the exact nature of the impediments to crystallization, and if possible to devise some means for their removal, he undertook the special examination which resulted last season, according to Mr. Stewart's report, in apparently complete practical success. He says the regular Chinese cane in Western Pennsylvania yields 200 gallons of sirup per acre; that on good common soil 300 gallons per acre is practically attainable by the application of gypsum, phosphates, and other special manures and good cultivation; and that eight pounds of sugar from corn and ten pounds from sorghum cane may be made from a gallon of dense sirup, and there is scarcely a county in the Union in which one or both of these plants cannot be successfully grown.

If the above statements should be proven, then it is demonstrable that if one acre in fifty of the area annually devoted to the growth of Indian corn in the United States be appropriated to the growth of either corn or sorghum for sugar, and properly worked up, the product would abundantly supply our present home demand.

I have solicited from the gentleman above referred to, for publication in this report, such an account of his investigation as he might feel authorized to give, and this has now been furnished in the article entitled "Maize and sorghum as sugar plants," to which the reader is referred. It will be observed that these experiments embraced chemical analyses made during various periods of the growth of the stalks of both *maize* and sorghum, and thus many facts not before known, or of a doubtful character, were established, and some errors in theory and practice made evident.

Among the former, the extreme rapidity with which the juice of these plants decomposes when exposed to the action of the air is to be especially noted and guarded against; and an example of a widespread error, which needs to be corrected, is found in the opinion that the cane (*sorghum*) commonly planted is rich only in grape-sugar, and is therefore worthless except for sirup. The reverse of this seems to be the truth. Some of our oldest varieties of sorghum are shown to be among the richest plants in cane-sugar grown. He informs me that practical experiments were made in all cases where it was necessary to confirm the results of analysis.

The first successful experiments were made by Mr. Stewart upon the juice of Indian corn, and a brief notice of the same was published in the Philadelphia *Public Ledger*, of December 1, 1876, and some samples of the sugar were shown at the Centennial Exhibition, near its close, but the system was not then perfected, and its applicability to sorghum had not been tested; but this it is claimed was fully done last season.

Stowell's evergreen corn and the Chinese cane, in his opinion, stand at the head of their respective species both in productiveness and quality; but no special preference for saccharine richness is to be given to any one of the old-established varieties above the rest.

Mr. Stewart exhibits a natural hybrid between the Chinese cane and the red imphee (*schlagoova*), which yields fully as well as the former, ripens fully a month earlier than that sort, and possesses a juice of great richness and purity.

This new variety is the result of growing the two sorts from which it is derived alongside of each other for a series of years in Pennsylvania. The hybrid for two or three years has shown constant characteristics, which may probably be considered permanent.

In the further growth of this comparatively undeveloped source of sugar, the possibilities of which seem so vast and magnificent; in the extension of the scientific principles therein employed to Chinese and African sorghums; in the examinations now making in Europe of the best methods there employed in the production of beet-sugar, and their adoption here; and last, but by no means least, in the fresh impetus it is possible in many ways to impart to the now languishing cane-sugar interests of Louisiana and other Gulf States, we have a four fold confidence that we have reached the end of our retrograde movement, and that at no distant day, instead of being importers, as now, we shall become exporters of sugar.

I have thus drawn attention to this subject, in some of its most important features, with the hope that this department will be seconded by the agriculturists of the country and by the legislative department of the government in its efforts to render the nation, within a few years, wholly independent of foreign countries for its sugar supply.

MAIZE AND SORGHUM AS SUGAR PLANTS.

BY F. L. STEWART, *Murrysville, Pa.*

The greatest labour they take in planting their corne. In April they begin to plant but their chiefe plantation is in May, and so they continue till the midst of June. What they plant in April they reape in August, for May in September, for June in October. Every stalke of their corne commonly beareth two eares, some three, seldome

any foure, many but one and some none. Every eare ordinarily hath betwixt 200 and 300 graines.

The stalke, being greene, hath a sweet juice in it somewhat like a sugar cane which is the cause that when they gather their cane greene they sucke the stalkes for as we gather greene pease so do they their corne being greene which excelleth their olde.—[From the "True Travels, Adventures, and Observations of Captaine John Smith—Account of 6th voyage, A. D. 1606, 2d Booke," London ed., A. D. 1629].

The characteristic bread-plant of this continent is maize. Its discovered uses are so numerous, its products are so multiform, its vigor and productiveness are so wonderful in this its original home, as to give it the very foremost rank among cereals for the benefit of man. The superiority of American corn passes unchallenged in the great grain marts of the world, and we have been accustomed to consider that our knowledge of the economy and uses of the plant are well-nigh complete.

When Captain Smith landed in Virginia, nearly three centuries ago, what he saw of the plant and its uses he rehearsed to his countrymen on his return in a minute and interesting narrative, of which a brief extract is given above, and from which it is evident that the Indian tribes occupying the eastern shore of America at that day were more of an agricultural people than has commonly been supposed, and the recognized uses of maize among them were widely different from those now in vogue. Its saccharine qualities were no less distinctly recognized than its value as a cereal, and the grain, both for immediate use and for preservation, was most esteemed in the immature state, when the "honey of the maize" was in its prime.

This twofold use of unrefined corn did not escape the notice of the Spanish conquerors of Mexico and Peru during the preceding century, when the plant was discovered. It is certain that in Mexico some sugar had been made from it at that period; but the chroniclers of the conquest drew their pictures with a free hand, and it is extremely improbable that the production had attained to any importance. This appears from several circumstances, among which is the fact that maize-sugar had no prominent place, at least, in the vast enumeration of articles provided for the royal cuisine, which it certainly would have held if it had ranked as a staple of the country.

The nature of this juice is such that it yields, with comparative facility, by ordinary treatment, a small proportion of its sugar, two or three per cent. We may infer, as in the case of some experiments made in this country a short time before the introduction of the Chinese cane, sugar was not obtained from it in remunerative quantity, and that is no evidence to show that sugar-making, as it existed among the Aztecs, can ever be claimed as one of the "lost arts."

Yet these statements, if not altogether mythical, have certainly some practical significance. At this time, with a peculiar force, the question comes up for answer: Has Indian corn, at any period of its growth, a definite value as a sugar-producing plant?

No sufficient reply has ever been made to this question. Believing it to merit at least a thorough examination, the writer, more than two years ago, undertook some researches that have been conducted with patience and care up to the present time, and sufficient results have now been reached to furnish a decided and intelligent answer.*

* Prescott extols the noble growth and saccharine qualities of the maize in those equatorial regions, and refers to the sugar made from it. Conquest of Mexico, rev. ed., 12 mo, 1874, vol. 1, p. 139. Carta del sic Tuazo, M. S. Oviedo, Hist. Natural de los Indias, cap. 4, ap. Barcia, tom. 1; Hernandez, Hist. Plant, lib. 6, cap. 44, 45, are the authorities which he cites.

But in the course of this investigation, it was very soon discovered that maize juice in certain important particulars bears a strong resemblance to that of another notable plant now domesticated in this country, the value of which has been much debated, and the peculiarities of which have hitherto been very imperfectly understood—the Chinese sugar millet or sorghum.

Although the plants are strongly contrasted in some respects, it was discovered that they are so intimately related in chemical constitution as to entitle them not to be ranked together, but to separate them by a wide interval from all the known sugar plants. Natives of opposite hemispheres, they seem to have been brought together to fulfill a common destiny.

New and interesting peculiarities presented themselves in the juices of these plants, foreshadowing the necessity of improved modes of treatment, and it was at once perceived that but little practical benefit would result from an investigation, however wide its range or important its disclosures, unless a process could be devised capable of the extraction of the sugar as uniformly and certainly as, by special processes adapted to them, it is now obtained under favorable circumstances from the beet and Southern cane.

It may be confidently affirmed that not only maize in the green state, but also the Chinese and African canes, are beyond comparison superior to any other plants that can be grown in the United States for sugar production, either as to certainty of results, abundant and regular yield, ease of culture, or cheapness and facility of manufacture.

It is difficult to express in a few words the importance of this statement. It will be readily seen that the natural resources of the United States for sugar production from these plants are practically limitless, if the facts here assumed be well established. A single illustration bearing upon this point will suffice.

The area of land annually planted in Indian corn, of late years, in the United States averages 45,000,000 of acres, as shown by the reports to the Department of Agriculture at Washington. It is demonstrable that if the average sugar-producing capacity of either sorghum or Indian corn per acre of ground be taken at one-third less than the experiments of the past year show it to be clearly equal to, if the crop be grown and worked up with ordinary skill and care, it would require less than the one-fiftieth part, or one acre in fifty, of the acres annually devoted to the Indian-corn crop in the United States to support a growth for sugar of either sorghum or maize which would be fully adequate to supply the whole immense home demand for sugar, in value now equal annually to one hundred million dollars.

It can now be shown that we have the resources at perfect command, if rightfully utilized, to save to the country this vast sum which we are paying in gold every year for foreign sugars; but that in a few years hence we will be able to send to other markets a surplus of our crop, which will take equal rank with our exports of flour and corn.

To accomplish this it is not necessary that any delay should be now incurred, or that any preparation should be made involving changes in the modes of agricultural labor to which our people have become used. Nor have we to spend time in experiments new to us or to our climate and soil. To insure our success, we need not invoke the presence of any other agencies than those which the Creator has so lavishly and so opportunely laid to our hand.

The failure to recognize the value of these plants heretofore is surprising, but it is not at all unparalleled. Some of the grandest industrial

monuments of the present century were not even foreshadowed during the last. It is no disparagement to us that through the swift strides our country has taken during the past fifty years, in some fields of material progress we have overstepped in our haste some mines of wealth which the surface concealed. The corn-plant of America, in common with many other of our indigenous productions, was not appreciated at the time of its discovery. It was recognized as an invaluable acquisition by the early colonists, and perhaps a proper estimate of its value would have been reached in the old countries if the dazzling splendor of riches brought home by the Spanish adventurers had not blinded the eyes of all Europe to all discoveries but those of gold and silver. In the enthusiasm of the time the old dream of the alchemist seemed at last to find a realization in the teeming wealth of the mines of the New World, and men were well content to accept, as the power to bring it forth, the steel of the conquistador instead of the philosopher's stone.

A full century later it was a fashionable hobby, with European writers like Abbe Reynal, to assume the essential inferiority of the productions of the New World (a mistake which the Old World has learned to correct). This whimsey imposed itself upon the sober sense of no less a naturalist than Buffon. It repressed investigation and threw into discredit knowledge by which a later age profited by estimating at its worth, and it must be remembered that it was not until another century had rolled by that modern chemistry and the systematic "interrogation of natura" took its rise. It may be said, too, that our forefathers in this hemisphere had no immediate wants which the almost unbounded resources of the country did not supply without calling forth much technical skill, and prior to the year 1850 no crisis in the commercial history of the nation had stimulated research toward the discovery of an adequate native source of supply of sugar such as gave life to the beet-sugar industry in France.

Still it is not a little remarkable that half the value of the plant in American agriculture has, for these three hundred years, been practically ignored. Scarcely less so is the fact that a plant so rich in sugar as sorghum cane is now shown to be should have been grown for almost a quarter of a century in this country, and in Asia from time immemorial, without any adequate realization of its value.

1. CRYSTALLIZABLE SUGAR.

It is important that there should be no misapprehension as to the nature of the product now furnished by these plants.

Although chemistry recognizes a distinct class of substances to which the general term of sugar is applied, there is but one body in nature recognized in the commercial world to which the appellation of crystallized sugar can properly and honestly be applied. It is exclusively a natural product. It must pre-exist in the living plant. It cannot be counterfeited or made. In its association with other bodies in the sources from which it is obtained its presence is ofttimes only indicated by the nicest chemical tests. To break the alliance subsisting between it and the substances often in great number found along with it, and to separate the sugar without destroying it, is in many cases one of the most difficult problems in organic chemistry. And it becomes a new problem involving new modes of treatment every time that a crude saccharine substance is brought under examination of a different organization from others already well understood.

Sugar as it exists in tropical sugar-cane, in the maples of our forests,

in the beet, in the sorghum, and in maize, is, in its purified form, precisely the same. In saccharine value no other substance can at all compare with it; no other possesses the same crystalline form, the sweetening power, or the same chemical construction and adaptation to the uses of man as an article of food. This distinction is necessary to be made at the outset, because Indian corn has recently obtained some celebrity as a sugar-plant in its capacity to furnish, from the *starch of its grain*, by a well-known transformation, the miserable *starch sugar* to which, by an amazing stretch of courtesy, the name of "corn sugar" has been applied. The misnomer should deceive no one.

I now propose to state more particularly the grounds upon which the foregoing statements of the value of maize and sorghum in this respect are based. To do this fairly, and with the conciseness which is necessary, a comparison is made in all important points between these plants, respectively, and the beet and the Southern cane. From this the reader will be able to decide as to their relative value for sugar production, at least in the United States. The authorities cited for the cane and beet are among the most eminent and trustworthy names associated with the sugar industry of the United States and elsewhere.

SUGAR PRODUCTION IN LOUISIANA.

Although it is possible that sugar production from the tropical cane in Louisiana at certain points, and in a few other favorable localities, may be extended in the future so as to utilize to the utmost all available resources, and restore it to a condition of comparative prosperity, still it must be admitted upon all hands that we cannot in coming years reasonably look to that source to supply more than a small fraction of the sugar annually consumed in the United States.

The decline of this industry at the South during the decade preceding the late civil war was due to natural causes, affecting the growth and development of the sugar-cane itself. After years of careful experiment it was at last plainly and painfully evident that the transplantation of an exclusively tropical plant into the narrow fringe of extra-tropical territory along our Gulf coast, where alone it will grow at all, was in violation of a law of the life of the plant, the ultimate result of which was disease and decay.

It was of no permanent avail that government aid was invoked and freely given, and cuttings of new and undegenerated varieties were introduced from the most distant quarters of the globe. Nothing was left undone to foster an industry which, when it was temporarily successful, so abundantly rewarded capital and skill. Never was the ingenuity of the American mind more conspicuously displayed or more enthusiastically bestowed than in the attempt to supplement by human invention and assiduity the lack of needed qualities in the sun and air of Louisiana. Apparatus of rare workmanship and enormous cost were employed in the manufacture of the sugar, and not without reward, for in quality the sugar of New Orleans soon enjoyed a marked pre-eminence; but nothing could countervail a climatic defect by which the frost of a single night would wither the hopes of the planter for a whole season, or arrest the deterioration of his best imported canes. Contrary to a wide-spread belief the civil war was not the immediate cause of the prostration of this industry, although it precipitated it; and now, notwithstanding so many years have elapsed since its close, during which the stimulus of high prices has been constant, the business has not revived, and every year the disparity between the supply from this source and the demand is

becoming greater. Nature has plainly set barriers to the geographical range of the plant, beyond which it cannot be grown with success. It is only within the heart of the tropics that the regions are found from which the markets of the world are now supplied, or can be expected to be with any regularity in the future.

RESULTS OF EXPERIMENTS WITH MAIZE AND SORGHUM.

The facts adduced as to maize and sorghum have been derived from a great number of analyses and practical experiments, a detailed account of which would be inadmissible in a brief article like the present. The chemical investigations were conducted after the most approved methods now in use. For the quantitative determination of the sugars Fehling's standard cupric solutions were generally employed. The plants tested were used when freshly cut from the ground unless it is otherwise indicated, and they were taken at all periods of their growth, from the time when sugar began to be developed in the juice until it ceased to yield it in remunerative quantities. Many varieties of both species were tested. The action of manures upon the juice of growing plants, the influence of different soils and seasons, the effect of diverse modes of planting and culture, the comparative value under various modes of treatment of some of the most prominent varieties of corn grown for sugar alone, and for sugar as combined with the preservation in the best condition of immature grain, and the utilization of other products, have all received more or less consideration. But the most prominent attention was bestowed upon the characteristics of the juice itself, in order to secure the separation of the sugar.

In the course of this examination many preconceived opinions, both of myself and others, were shown to rest upon insufficient grounds. But it is especially gratifying to me now to say in regard to the sorghum that howmuchsoever the published opinions of some eminent chemists are apparently at variance with each other, no well-established fact is discordant with what is now known. The truth as far as ascertained harmonizes all the facts. Notwithstanding the great diversity prevailing among different varieties of the same species in other respects, the most remarkable uniformity was found to exist in the chemical constitution of the juice at the same stage of growth of the plant.

The results of these experiments, so far as they relate to maize, were announced for the first time in the Philadelphia Public Ledger of December 1, 1876, and specimens of sugar were displayed at the Centennial Exhibition toward its close.

During the present year those results were fully confirmed, and at the same time the applicability of the process to the crystallization of the sugar of Chinese cane and the African varieties was fully established. In fact, the facility with which sorghum-juice crystallizes under this treatment is as remarkable as its obstinate refusal to do so under any other.

1. BOTANICAL RELATIONSHIPS.

Sorghum, maize, and the tropical sugar-cane are closely related. They are all simply gigantic solid pithy-stemmed grasses (not reed-like or hollow), charged at a certain period of their growth with a rich saccharine juice. There are numerous well-defined varieties of each.

The beet is remarkable as being a member of a peculiar order of plants, to which belong such alkaline sea-side plants as the sampphira, saltwort, and obione. Of the same family is the common worm-seed (*Ambrina*

anthelmintica). It is probable that its saccharine character has been developed largely by cultivation. Of the many varieties of beet only the white-fleshed kinds, especially that known as the Silesian, are adapted to the production of sugar.

2. PERIOD OF GROWTH.

Sorghum.—Annual, at least in temperate latitudes. The length of the period of growth differs with the variety, varying from three to five months.

Maize.—Annual, ripening its seed in from three to five months in North America.

Sugar-cane.—Perennial from the root-stalk in the tropics, flowering in from twelve to twenty months. In Louisiana it never matures its seed.

Beet.—Biennial, ripening its seed the second year from the planting, but maturing its juice during the first season in the root. The time required for this purpose is almost eight months from the time of planting.

3. PROPAGATION.

Sorghum.—Propagated from seeds planted in early spring. Much labor and expense is thus saved, which Louisiana is expending in the cultivation and care of seed-cane or cuttings.

Maize.—Annually during the summer from seeds. Enjoys equal advantages with sorghum in this respect.

Sugar-cane.—Propagated always in the sugar district of our Gulf States, and ordinarily in the tropics from cuttings of the stems (joints). In Louisiana, on account of constant deterioration, it is necessary to replant from cuttings every third or fourth year, one-fourth of the whole breadth of the land devoted to sugar-culture, being employed constantly in the propagation of the joints from which the cane on the other three-fourths is grown.

Beet.—By seeds annually. But unlike sorghum and maize, no seed grown from the crop which produces sugar. The expense known of growing beet for seed is trifling, however, to that incurred for the sugar-cane.

4. RATOONING OR TILLERING.

Sorghum.—The crop of sorghum is capable of large increase in each season by side shoots arising from the root. It cannot be propagated from the cuttings of the stem, but when the stems are cut down they ratoon like the sugar-cane. Mr. Leonard Wray has stated that in South Africa he grew ratoons of Neazane or White Imphee six feet in height, and in two months after the first cutting sometimes fifteen stems tillered out from one root. These ripened their seed. This mode of increase is precisely analogous to the tillering of wheat when it has been cut down by the winter frost, but unlike wheat, and like the sugar-cane in some climates it is increased, and a second crop of sorghum may be grown from the same root.

Maize.—This mode of increase is not at all a characteristic of maize.

Sugar-cane.—Ratoons regularly, as above described.

Beet.—Cannot be multiplied or propagated in any way analogous to this.

5. CLIMATE.

Sorghum.—The climate of the whole territory of the United States south of Alaska, where the soil is not barren and the moisture insufficient during the summer months, is adapted in various degrees to its growth.

Maize.—A little more sensitive to cold than sorghum. All over the Union where sorghum will thrive it may be grown, especially as it matures its juice within a shorter period.

Sugar-cane.—Production within the United States restricted to a very narrow belt of country bordering on the Mexican Gulf.

Beet.—May be grown for sugar in the latitude of the Middle and Northern States generally, but not at the South; but it will yield sugar remuneratively only where the summer rain-fall is equal to that of spring, and the natural peculiarities are not unfavorable.

6. SOIL.

Sorghum.—The most suitable is a deep, rich, well-drained, and calcareous soil.

Maize.—The richest and deepest natural soils, moderately enriched. Not so sensitive to excess of moisture in the soil as sorghum.

Sugar-cane.—A deep, rich, moist loam the best. First crop off new lands yields most sugar.

Beet.—Similar requirements to the above as to depth and high fertility, but is very much more sensitive, and our best natural soils—the alluvions and prairies—have proved unfavorable to it.

7. MANURES.

All these plants yield juices less rich in sugar and containing more impurities when supplied liberally with animal manures or those containing nitrogen in large proportion; but lime, gypsum, and the superphosphates may be used without detriment, and sometimes with immense advantage.

8–10. CHEMICAL COMPOSITION.

The stem.

Constituents.	Sorghum.	Maize.
Sugars 12	12.0	10.8
Woody fiber, mucilaginous, resinous, albuminous matter, and salts	22.2	19.8
Water	65.8	69.4
	100.0	100.0

Constituents.	Sugar-cane.			Sugar-beet.
	Avequin, La.		Dupuy.	Payen, France.
	Tahiti cane.	Ribbon-cane.	French colonies.	
Sugar	14.28	13.39	17.8	10.5
Woody fiber, mucilaginous, resinous, albuminous matter, and salts	9.64	9.88	10.2	6.0
Water	76.8	76.73	72.0	83.5
	100.00	100.00	100.0	100.0

The juice.

Constituents.	Sorghum.	Maize.
Sugars	13.5	12.0
Organic matter and salts	1.7	1.6
Water	84.8	86.4
	100.0	100.0

The juice—Continued.

Constituents.	Sugar-cane.		Sugar-beet, (estimated).
	Avequin, La.	Evans.	Payen.
Sugar	15.78	18.2	10.66
Organic matter and salts	0.38	0.8	4.57
Water	83.84	81.0	84.77
	100.00	100.0	100.00

The intelligent reader, from the comparison as instituted above, will draw many inferences of value to which I make no reference.

SORGHUM AND MAIZE AS COMPARED WITH THE SUGAR-BEET.

It is with the beet-sugar manufacture perfected, as it has been in its processes and appliances, that we must make the closest comparison; and, that it may be made with the utmost fairness, we assume as true what has been by no means proved by the experience of those who have fostered it here—that it is capable of being carried on in the United States as successfully as it is in France and Germany.

But it is well known that at the very limited point of his work the beet-sugar manufacturer here encounters the discouraging obstacle, hitherto insurmountable, of securing cheap labor for the growing of the raw material. Independent of the great expensiveness of the machinery and the process employed, and the high degree of skill required, it is necessary that radical changes should be made in the means and methods of agricultural labor now existing, together with the great loss of time necessary to make such changes.

On the other hand, the cultivation of Indian corn and its now fully acclimatized relative, sorghum, is reduced here at present almost to a science.

It may be said that we have scarcely anything new or valuable now to learn in regard to the growth of either of them. By means of labor-saving implements and skill in the use of them, here, if anywhere, their cost is reduced to a minimum. No American who visited the Centennial Exhibition at Philadelphia and compared the maize of the valley of the Nile, of the plains of Hungary, of Portugal, Italy, or France, with the product of the valley of the Kansas or of the prairies of Iowa and Illinois, but must have felt that in all that pertains to the production of these cereals we are unrivaled by all the world.

But our very success is our peril. The overproduction of corn has been almost the bane of our Western agriculture. The ease with which it is grown has a fascination to the farmer on the prairies which it is difficult to resist—so great that ofttimes to him the lack of transportation and glutted markets do not even suggest a remedy for the evil. The statistics of Washington abundantly show that in the case of this crop unrequited labor almost invariably follows in years of largely increased yield. It is just here that the new industry comes in to give immediate relief to the unremunerative labor, by turning a part of the already overflowing stream into a new channel, thus utilizing our greatest waste to supply our greatest want.

It is from the uprising of such an industry as this that the highest benefits resulting from the division of labor among our people may be realized. It may be established without a jar in the routine of agricultural work, or any inroad upon established usages. The redundant population of the cities will flow out to meet the thus newly-created

demand for laborers, and the solution of the much-vexed question may thus almost insensibly be reached.

If sorghum be grown by preference, as will often be the case, we have the advantage that it has been long enough in the country to make us familiar with all its requirements as to climate, soil, and cultivation. It is scarcely to be regretted that its full value has not heretofore been realized, for it is not probable that the attempt by our people to supplement by mechanical devices of rare ingenuity for the evaporation of the juice a defective knowledge of chemical requirements would have been made to the same extent as now. This concentration of inventive talent upon a single point, although it was not the most important one, led to the discovery of some principles in the evaporation of saccharine juice which had been overlooked. To have learned thoroughly the fact that proper evaporation, at the atmospheric pressure, of thin films of liquids containing sugar may be made to equal the results of boiling in a vacuum, is worth the past twenty years of baffled expectation. All over our land there is a large amount of capital invested in sugar-apparatus now almost idle—the result of the early interest taken in Chinese cane. Most of this, although regarded in many quarters as slight and insignificant, is just what is needed at the start in this industry; and it is widely distributed over the country and in intelligent hands. Serving a present purpose, it will lead inevitably to the rapid introduction of more perfect machinery, and to all the gains resulting from concentrated capital and skill.

These considerations, together with the fact that the crystallization of the sugar is reduced to an absolute certainty, have their value more than doubly enhanced by the circumstance that from the very outset our choice lies between maize and a still richer saccharine plant of similar requirements as to soil, climate, and general modes of treatment, but sufficiently diverse to enable us to use the one to supplant the other under a variety of circumstances, when either could not be used so well alone, both capable of having their sugar extracted by the same process, and thus giving a combination of advantages such as belong to no single sugar-plant.

There are also a large number of well-established and clearly-marked varieties of each, giving us a much wider range of subordinate qualities to adapt them to meet diverse local peculiarities of climate than are secured by any existing varieties of the beet, and the probability of still further improvement in this respect may safely be predicted.

It will be observed that the period of growth of either plant, when used for this purpose, and the time while they occupy the ground, *is less by one-half* than is required by the beet; and consequently the profits of a second crop, of another kind, the same season, are easily procurable from the same ground, when it is well cared for, and are to be credited to these plants as against the beet.

The expense of preparing the ground and planting the seed is about equal for all these plants, and they have thus a great advantage over the tropical cane.

CLIMATIC RANGE OF SORGHUM AND MAIZE.

The climatic range of these saccharine cereals on this continent is vastly greater than that of the beet. It is also to be noted that a broad area of territory, within which it would be possible to grow the beet, toward the South, affords plants with a juice too weak to be profitable and too liable to fermentation for the establishment of factories there, a temper-

ature of 60° F. during the working season being fatal to this pursuit with existing processes. The latitude of 45° is the limit in France.

No such extreme delicacy of organization characterizes maize or sorghum, and their juices are equally strong under the summer sun of either Texas or Maine.

Deficiency of moisture during our early summer—a very common occurrence—almost ruins the beet crop for sugar, and it is partly the cause of its deficient yield here. But maize can mature its juice in a season of early summer drought, being planted as late as July, in the latitude of Pittsburgh. The beet, on the contrary, requires the whole season to ripen.

SOILS.

In point of adaptation to the rich, deep, natural soils of our Western prairies and the alluvions of our rivers, no plant grown either for sugar or grain, perhaps, ranks equal to Indian corn. Sorghum ranks equally as well upon them if they are not deficient in drainage, but heretofore beet-growing upon the prairies has met with but little success. Among the causes of failure the preponderance of nitric salts in the juice, derived from the soil, is assigned as the first.

EFFECTS OF MANURES.

All sugar plants suffer from the effects of manures abounding in nitrogen directly applied, but the presence of certain mineral salts in constant quantity generally for each species shows that they require a soil rich in all the ordinary elements of plant growth. Normally, the azotized substances in all three of the above are not far from equal. But the presence in the beet of a great amount of mineral salts, which cannot be eliminated in process of manufacture, destroys utterly the value of the molasses for ordinary use. Indian corn, for a similar reason, does not afford as palatable a sirup as sorghum. The latter, in this respect, is capable of taking, when the sirup is purified, a front rank among plants of its class, and in the quantity of crystallized sugar which it produces, it stands next to the Southern cane. It has been the aim to limit the amount of molasses (drainage) from either plant by the new process almost entirely to the glucose originally in the juice, and this has become so nearly realized in the case of sorghum as to enable us to extract 10½ pounds of crystallized sugar from 13 pounds of very dense sirup readily and uniformly, a result which, in the practical manufacture of sugar, is almost unparalleled.

COST OF PRODUCTION.

But it is in the vastly diminished cost of the production of well crystallized sugar from these plants by the means now discovered, as compared with that from the beet, that the most marked disparity exists. In sugar-producing capacity the Chinese cane is in advance of Indian corn in the proportion of 12 to 14, or 6 to 7; but the greater value of the grain of corn (well dried sweet-corn being worth about $20 per barrel of 300 pounds), as compared with the grain of sorghum, fully compensates for the deficiency of sugar. The almost absolute certainty of realizing a large return from both the dried sweet-corn and sugar in our long summers is a strong argument in its favor. In this case, of course, only a large-stemmed and large-eared variety of sweet-corn should be grown. The amount of molasses (drainage) from either is small, but

greater in case of maize, while that from sorghum is comparatively fine flavored and free from mineral salts.

The greatly diminished cost of growing these plants, as compared with the beet, arises from the peculiar adaptation to them of our soil and climate, the use of our greatly improved agricultural implements, and substitution largely of animal instead of human labor.

But the disparity in cost becomes widest when the processes of manufacture are contrasted. Some appreciation of this will be realized when it is stated that the three items of expenditure in the beet-sugar processes are, viz., *Bone-black filtration*, *carbonation*, and *vacuum apparatus*, in this entirely thrown out; the first two are entirely useless and the last is unnecessary in this production. In the largest maize and sorghum sugar-factories a preference may perhaps be given to vacuum finishers, but in operations of less magnitude the comparatively simple and equally effective and rapid system of final evaporation of sirup in thin films and at a low temperature will prevail.

IMPROVEMENT OF THE SOIL.

Not the least of the advantages that will result from the new sugar industry in the United States, will be in the improvement of the soil. Some of the rich soils of the West have borne successive crops of corn for more than twenty years, in which cases, generally, the grain was marketed, and the soil has been depleted of its most valuable mineral constituents.

Even on these soils the effects of such a system are now becoming apparent. But if sugar is grown, and the soft grain in the dried state only sent abroad, but little will be necessary to be returned to any soil already in good condition to maintain its fertility for this crop. The elements of sugar being derived from the air and water only, it abstracts from the soil nothing valuable, if the trash be carefully returned; while the ashes from the furnaces and all residual chemical products will, if properly applied, constantly supply more of the salts, &c., than immature grain takes away. But with somewhat less profit the soft corn and the seed of the sorghum may be fed on the ground, and a constant accession of the elements of fertility be thus secured to the soil. Besides, the thorough tillage which the business demands will go far to inaugurate, when it is lacking, a national system of farming, increase the value of land, and cheapen production.

The maximum crop of sugar-beets that can ordinarily be grown when an acre of ground is found to be such as to allow the rows in which they are planted to be one foot ten inches apart, and the plants one foot six inches asunder in the rows, thus producing over 21,000 beets to the acre. It is not profitable to grow beets of very large size for this purpose. They ordinarily weigh from one to three pounds each.

YIELD PER ACRE.

It is not possible as yet to determine the maximum product of corn or cane attainable. I do not think that the best yield yet reported has reached that limit, nor perhaps can the mode of planting be indicated by which it can be secured. I recommend, however, to plant in rows three feet apart, the hills at intervals of twenty inches apart, so as to admit of cultivation *across* the rows once or twice in the season, by an implement, drawn by horses, passed between two or three of the cross rows at once. The rows should be laid out with accuracy. The number of

plants to the hill to number from 2 to 4. The weight of the trimmed canes to the hill 2 to 8 pounds. The stems of evergreen corn in Pennsylvania will average 1 pound each, varying from 12 ounces to 48 ounces each. Single trimmed stems of Kansas corn have equaled 6 pounds each, but the juice of this giant growth is more impure than those of the inferior size; but an average of 3 pounds of stem to the hill will yield 21,700 pounds to the acre, giving 180 gallons of dense sirup, or 1,800 pounds of crystallizable sugar, and 44 gallons of drainage molasses. It a growth of four pounds to the hill is secured (an average easily obtained upon good soil with good culture), 2,400 pounds of sugar and 55 gallons of molasses will be obtained from 225 gallons of dense sirup.

From experiments made the past summer, I conclude that an attainable limit for corn is 270 gallons of sirup per acre, 5 pounds of stem to a hill, and 3,000 pounds of sugar and 66 gallons of molasses, upon ground which would readily yield 100 bushels of corn to the acre if grown for the grain, and which, if planted in sugar-beets and tended with the usual care, would yield about the same amount of sugar. If sweet corn (evergreen) be grown for the grain and sugar combined, a reduction of one-third will have to be made in the yield of sugar in each of the above estimates, respectively. The yield of sorghum in sugar will be about one-seventh greater than of corn in each of the above instances. From 100 to 350 gallons of sirup, so dense as to seem to be almost a solid mass of sugar when crystallized, can be secured ordinarily by sufficiently close and regular planting, good cultivation, and a thoroughly prepared soil. Two gallons of such sirup per square rod of ground should in all cases be aimed at as an average attainment. Of course, while the means taken to grow a crop of corn or cane vary as widely as they have done hitherto, often without any regard to system or economical management, the average production will fall far below what it ought to reach. While the maximum yield of the beet has reached in Europe about 500 pounds, the average per acre in France has dropped to 1,071 pounds. The lowest remunerative yield of sorghum (100 gallons of sirup), will produce the same amount.

When it is considered that not a pound of sugar is wasted from the juice obtained at the mill, that the softer substance of the stalk both of corn and cane yields its juice in much larger proportion than that of the Southern sugar-cane, that the juice itself is from 10 to 50 per cent. stronger in sugar than that of beet, and the product of green fodder from maize in counties less favorable to its growth than our own has reached maxima much exceeding those upon which the above estimates are based, they will be acknowledged as fairly representing the capacities of those plants.

CORN AND THE BEET AS FORAGE PLANTS IN FRANCE.

In France, the home of the beet-sugar industry, extensive experiments have recently been made for the purpose of ascertaining the average yield of various plants for green fodder for stock, the process of *ensilege*, or fermentation in pits, being adopted for curing it. In the maize-growing departments of that country 26 to 35 tons of freshly-cut maize fodder per acre is estimated as the average yield. But far greater yields are announced in different quarters by higher culture. Upon a schistose sandy soil in the department of Finistère, limed and enriched with barn-yard manure and superphosphates, 44.61 tons (89,220 pounds) in one case, and 66.91 tons (133,820 pounds) in another, of the Caraqua, or giant maize, have already been produced there per acre.

M. Lecoreteaux,* in the Journal Pratique d'Agriculture summarizes the comparative maximum yields of maize and sugar-beet as fodder-plants, as follows:

Caraqua maize	66.96 tons.
Sugar-beets	35.68 tons.

Thus, in the gross yield for the same purpose, the *maize leads the sugar-beet by almost one-half;* one-third being deducted for weight of blades, immature ears, &c., will leave a weight of 44 tons or 88,000 pounds of trimmed stems per acre, equivalent to the enormous amount of 8,800 *pounds of sugar*, if juice was of the average quality.

One-half this yield is much beyond the maximum which we have assumed above for Indian corn here. It is asserted that 40 tons per acre of Chinese cane have been grown in the United States.†

The chemical composition of these plants and their juices I have made a subject of special investigation, a brief abstract of which is given in the foregoing comparative statement. The information thus gained, outside of its chief value in outlining a special mode of treatment for the extraction of sugar, possesses additional importance in its bearing upon other questions. One of these is whether a more exhaustive method of extracting the juice can profitably be employed to take the place of the ordinary cane-mills. The very great loss sustained in the expression of only the largest part of the juice of the Southern cane has led to the suggestion of a method of cutting the stem into thin slices, and exhausting the sugar by prolonged maceration and washing with hot water, and subsequent hydrostatic pressure.

The inapplicability of the latter method to the extraction of the sugar of the Chinese cane (and of maize as well) is decisively shown, if we consider the amount of soluble substances other than sugars contained in the stem, as compared with the amount of the same substances found in the juice when expressed by a sugar-mill.

A ripe stem of Chinese sorghum contains—

	Per cent.
Water	65.80
Sugar (crystallizable)	11.25
Sugar (glucose)	0.75
Gum	3.31
Pectin	0.60
Starch	7.15
Albuminoids	2.60
Cellulose	7.32
Oil	0.02
Ash: Silica, lime, potash, soda, peroxides of iron and manganese, chlorine, phosphoric acid, sulphuric acid, &c	1.20

I have found that by washing the rasped or thinly-sliced cane repeatedly with *cold* water it is capable of extracting 4.5 per cent. of the albuminoids, gum, and pectin, while but 2.4 per cent. of other substances than sugar is found in the juice as it leaves the mill; but if hot-water maceration be employed to dissolve out the sugar, an additional amount of pernicious substances escape with it, notably a large proportion of starch in gelatinous state, or *amidin*. It will also be observed that the combined weight of all the substances in the stem capable of being removed along with the sugars by acidulated or alkalized water, considerably exceeds the whole of the crystallizable sugar.

*Report of Department of Agriculture of United States, 1875, p. 404.
†Agricultural Report, 1857, p. 182.

On the other hand, the softer cellular structure of these plants as compared with the Southern cane, facilitates very much the action of the mill, and increases the yield of juice proportionally. While from 50 to 60 per cent. only of the juice of Louisiana cane is attained ordinarily by this means, from 80 to 85 per cent. from maize and from 70 to 80 per cent. from sorghum (Chinese) may readily be obtained, as recent experiments above duly show. When light mills are used repressing may sometimes be necessary.

The following results of analyses made during the past season are of interest chiefly as showing the relative proportions of sugars in these plants at different times during the period when the extraction of sugar is profitable:

Juice of maize.

Varieties.	Stage of growth.	Specific gravity.	Crystallizable sugar.	Uncrystallizable sugar.
			Per ct.	*Per ct.*
Pennsylvania yellow	Silk appearing; early flowering	10.44	6.98	1.92
Do	In early flower; roasting-ear	10.53	9.34	1.66
"Pop-corn," large	In early flower	10.44	7.25	1.65
"Stowell's evergreen"	Grain in early milk	10.60	11.34	1.56
8-rowed yellow	do	10.60	11.42	1.65
Kansas yellow	Grain hardening	10.51	9.86	1.04
Do	Stored two weeks { Two lower joints	10.62	10.48	2.52
	Stored two weeks { Middle and upper joints	10.71	9.80	5.20

Juice of sorghum.

Varieties.	Stage of growth.	Specific gravity.	Crystallizable sugar.	Uncrystallizable sugar.
Chinese (regular)	Flower just expanding	10.42	6.72	2.18
Do	In flower a few days { Butt joints	10.60	11.30	1.60
	In flower a few days { Top joints	10.53	9.75	1.25
Do	Seed ripening	10.58	11.52	1.18
Do	Seed quite ripe { Upper and middle joints	10.63	12.72	0.78
	Seed quite ripe { Lower joints	10.55	10.57	0.93
Do	Mixed juice, ripe and unripe	10.60	11.34	1.56
Red imphee	Seed in early milk	10.53	9.92	0.98
Do	Ripe	10.60	11.92	0.98
Black imphee	Coming in flower	10.53	9.98	0.92
White imphee	Not yet in flower	10.59	10.90	1.90
Do	Flower just expanded	10.57	10.30	2.20
Do	Seed nearly ripe	10.60	10.66	2.24
Chinese imphee {	Cut and stored (lower joints)	10.82	14.97	3.53
	Wisks (upper and middle joints)	10.82	16.19	2.31

OBSTACLES TO SUGAR PRODUCTION FROM THESE SOURCES.

The two principal causes of failure in all the attempts heretofore made to produce sugar from sorghum, and which would prove almost equally formidable in the case of maize, are, first, the presence in the juice, when in the best condition, of an almost constant quantity of glucose; and, second, the uniform presence of peculiar proteine and amylaceous compounds, which distinguish these from other sugar-producing plants; consequently, the extraction of sugar from them is a problem involving entirely new conditions.

It was found that the existence of these bodies in the juice presented an almost insuperable barrier to the modes of treatment adapted to the cane of the South, and to all the processes so successful and at the same time so tedious and expensive which are employed in Europe in the extraction of sugar from the beet. By common treatment with lime, the destruction

of the glucose and the speedy reduction of a large part of the sugar to the condition of levulose, the darkening of the sirup and the incapacity of the remaining sugar to crystallize, was the inevitable result. On the contrary, if no lime was employed no defecation was possible, and the juice retained within itself the active elements of its own destruction. Thus, constantly placed between Scylla and Charybdis, the practical operator was left without resource.

It has commonly been supposed that maize contained no grape-sugar. The prevalent opinion in regard to sorghum has been that it contains it in very considerable quantity. Both these opinions are now shown to be incorrect. But that they both contain uncrystallizable sugar largely, even in larger proportion than that which is crystallizable, is proved by every analysis made of canes not taken fresh from the field. Deterioration commences within a few hours after they are cut from the ground. And to this fact almost solely are attributable all the hitherto discordant results of chemical analysis. Plants were used which, although bearing no external evidence of it, were really, as to sugars, in various stages of decomposition.

In an article like the present, which is designed merely to call public attention to this subject in its most general features, it would be useless to enter upon the minute details of the process of sugar manufacture itself, which has been indicated, or to point out, except in a general way, the new and interesting relation of the chemistry of the subject to sugar manufacture, as it is at present understood. Suffice it to say that a body has been discovered to exist possessing the remarkable quality of isolating the sugars of both kinds in solution, and protecting them as by an impenetrable shield against the action of the forces by which the other deleterious substances are either neutralized or destroyed. This is accomplished expeditiously and cheaply, and it is hoped that the information herewith communicated will be found to be sufficient to secure, during this year, the successful inauguration of this new industry in the United States.

SYSTEM OF MANUFACTURE FOR GENERAL USE.

In the following pages I design to embody for general use the coming season the details of this system of manufacture as fully as the limits of a paper necessarily as brief as the present will admit of. Its practicability during the past year has been fully tested, and no part of it is recommended for general adoption which my own experience has not only sanctioned by repeated experiment as eminently practical, but, as in its principal new feature—the defecation of the juice—the sole discovered means by which the same ends can be attained. Its application is not limited to any special variety of either cane or corn, or by any varied conditions of climate or soil, as far as already shown. The common yellow corn yields its sugar as readily as the "sweet" corn of the gardens, and the refractory Chinese sorghum, hitherto held to be inferior to the imphees, and useless except for sirup, now seems to be unequaled by any sugar-producing plant in the world, except the Southern cane.

But it must be borne in mind that strict adherence to a well-defined system is essential to success. At the outset every available means should be resorted to to increase the productiveness and improve the quality of the saccharine plant itself. Care should be exercised in the selection of the seed, and in the choice of such varieties of corn or sorghum as will best serve the purpose of the planter. If he selects the corn, and has facilities for drying the immature grain, he will choose "Stowell's evergreen." If he designs to feed the soft corn to stock

during the working season, or after, he may take that variety, or any of the large-stemmed kinds of common yellow or white corn; and either by successive plantings at intervals, or by the selection of varieties of shorter or longer period of growth, he may extend his time for the working up of corn in proper condition from the 10th of August until the 1st of November in the latitude of the Middle States. The "seed of Stowell's evergreen corn," grown for the twofold purpose above mentioned, should always be taken from the upper and best-developed ear on the stalk; the stems should be stout and well developed, and producing not fewer than two ears each.

Among the many varieties of sorghum grown in this country the Chinese, Liberian, Oomseana, white and red imphee, are perhaps the most prominent. The Chinese cane is generally the most productive. The Liberian and white imphee are objectionable on account of late ripening, but they withstand prostration by the winds much better than the former, and hence are popular in the Western country. The seed should be selected from the earliest ripened and best developed canes.

PREPARATION OF THE SOIL.

The adequate preparation of the soil, and the mode of planting and cultivation best adapted to the crop, need not be insisted upon or discussed here, but this part of the work should be of the most thorough character. The soil should be naturally rich in all the elements of plant growth. Lime, gypsum, and superphosphates are all eligible as fertilizers; decomposed bagasse and straw, and also barn-yard manure (when it is not too largely used), are all appropriate when well incorporated with the soil. Only an excess of nitrogenous manures is to be avoided. The early planting and early cultivation of cane should be insisted upon. In general, the planting of a combined crop of corn and cane will be most advisable.

PERIOD OF HARVESTING.

The proper period for cutting corn, when it is a double-eared variety, is when the silk of the upper ear has become dead and the second ear is in early "roasting-ear state." The first will then have begun to harden slightly, but there is a little difference in the yield or the saccharine value from the time the first ear has its grain fully developed until the last ear has begun to harden, a period of about two weeks. "Evergreen sugar-corn" is in season for about three weeks. In the latitude of Philadelphia the grinding season will begin the first week in August.

One month later, or from the 1st to the 10th of September, the Chinese sorghum will be in condition, if planted the early part of April. The imphee or African canes may be worked up from the time the flower has made its appearance until the seed is ripe. The Chinese variety, from the time the glumes or external seed envelopes begin to darken in color until perfect ripeness. On account of the slower development of the large-stemmed imphees, the Chinese cane will usually be ready first.

CURING OF GREEN CORN.

In case of corn, the ears may be removed a week before the stems are cut without detriment. When the grain of sugar-corn is to be dried for the market, no time should be lost until it is properly cured. After being boiled for five minutes, it should be removed from the cob by cutting

instruments operated by machinery, and then dried as rapidly as possible in shallow pans, steam-heated, or on perforated plates placed on flues and constantly stirred. In from 4 to 6 hours it will be thoroughly dried if the temperature is maintained at, but not allowed to exceed, the point at which the grain remains uncolored by the heat. If the operation is properly managed the dried corn should be as free from color as when cut from the cob. In the retail markets this corn bears about the same price as brown sugar. As a secondary product its manufacture would be profitable at less than half that rate. It should be packed in barrels when dry. This grain is nearly equal to green corn, fresh from the field, and in its nutritive properties and capacity to fill a place otherwise unoccupied as an article of diet, it is an important product. In its nature and uses it is very different from the ripened grain of common corn. We are thus enabled to produce at will practically two different varieties of grain from the same plant. The popular demand for dried sweet corn, both in our own country and in Europe, will always render its production a valuable adjunct to sugar manufacture from maize.

PRECAUTIONS TO BE OBSERVED.

I must refer here to an error into which operators are likely to fall, and which cannot be too strongly condemned. There is now the most certain evidence to show that a profound modification of the juices of these plants, setting in at the base of the stem and gradually progressing upward, begins to take place within a very few hours after they have been cut from the ground. The storing of cane for considerable periods before it is to be worked up has been a common practice heretofore, but the transformation and loss of a part and finally the whole of the crystallizable sugar is the uniform result. Therefore, it should be insisted upon, as a general rule, that *both corn and cane should be worked up within 24 hours of their being cut in the field.* In other words, the successive operations of blading, topping, cutting, removal from the field, extraction of juice, defecation, evaporation, and crystallization, should directly follow each other, without any loss of time. The contact of freshly expressed juice with the air is extremely injurious if prolonged for more than an hour or two. There is no point in all these successive stages of work at which it will be safe to suspend them or take rest until the defecated sirup has reached a density of about 25° Baumé.

Store room, therefore, need be provided for only such an amount of canes as can be worked up in a single day. The crushing-mill should have sufficient capacity to extract with ease the juice of a considerably greater amount of corn or cane than has been apportioned regularly to one day's work.

CRUSHING-MILLS.

The inefficiency of crushing-mills is a source of great loss. The soft texture of the stem of cane, and especially of corn, makes this inexcusable. But the best mills may be abused by grinding at too high a rate of speed. And this is very commonly done. Good results are obtained by rollers which develop a surface of four or five yards in length per minute, so that a roll of two feet in diameter should only make from two to two and one-half revolutions per minute, in order to extract generally the largest amount of juice from a given weight of canes. An increase in the capacity of the mill that is required may be easily obtained by increasing the length of the rolls, rather than their velocity. The fresh undried stems of corn and cane contain about 85 per cent. of their weight of sac-

charine juice. The ordinary crushing-mills extract but 50 to 60 per cent. of the weight of the stalk; most of the higher class of mills do not average more than 50 per cent. A perfect machine would produce 85 per cent. If in practice but 50 pounds are obtained, 35 pounds, or more than 41 per cent. of the whole amount of juice originally contained in the stock, is still retained in the bagasse. We have thus revealed the astonishing fact that about five-twelfths of the crude material is thus utterly wasted at the outset in consequence of the imperfect means ordinarily used in extracting it.

In the case of common mills of small power a largely increased yield of juice will follow the *repressing* of either corn or cane. If the loss of of time incurred in this is urged as an objection, it may be replied that there is no waste of material in sugar manufacture that is justifiable, and that there is none so utterly inexcusable as that caused by the failure to extract all the juices practically separable, after a previous expenditure of time and labor in producing the crop, which is just as great when the canes are half exhausted of their juice as when they are wholly so. The difference between the product of an efficient and an inefficient mill may be almost equal to the difference between a half and a full crop.

The mill should be placed upon such an elevation that the juice as it is received from it by a pipe into the defecating tanks hereafter described, and from them into the evaporating apparatus as required. A strainer of wire gauze should be placed at the outlet of the receiving-tank at the mill to arrest any of the coarser impurities, such as fragments of cane, pith, &c., that may be floating in the juice.

HEATING-TANKS.

Two heating-tanks of equal capacity, 100 gallons or more each, to be used alternately, are to be so placed as to receive the juice as it flows from the tank at the mill, and at such an elevation as to empty readily into a broad cooling-tank, which supplies the evaporator continually. The tank last named may be made entirely of two-inch plank, closely jointed, 15 inches or more in depth, and capacity equal to that of the two heating-tanks combined. The latter may be entirely of metal (copper preferred), or they may have bottoms of sheet copper and upright wooden sides, and placed over the flue of a separate furnace in small works; or they may be heated by a steam coil or a jacket, which is preferable, in order that the ebullition of the juice may be immediately checked when the scum has perfectly formed on the surface. If they can be heated over an open fire, there should be an arrangement for throwing off the heat into another flue by means of a damper when the proper temperature has been reached. It is convenient to have these heaters large enough to contain each as much juice as is received from the mill in an hour.

EVAPORATING APPARATUS.

The evaporator may be of any required capacity, preferably with sheet-copper bottom, and of any of the best forms now in use in sorghum manufacture, provided that its construction admits of the continual descent of a thin sheet of juice over a large heated evaporating surface, with convenient arrangements for the removal of the scum which forms immediately when the juice enters it. It is rarely the case that the form of the evaporator will admit of the sirup being reduced in it to a finishing point.

FINISHING-PAN.

Instead of attempting to finish in the evaporator it is much better to have a small furnace detached, over which a plain, flat copper or perfectly smooth and clean iron pan is placed; or it may be so constructed as to be heated by a steam-jacket. If heated over a flue, the most convenient finisher, perhaps, is a tilt-pan. A suitable size is 3 or 4 feet in length and breadth, and 8 to 10 inches in height, the sides vertical, and the bottom perfectly smooth and flat. It should be placed upon a furnace the diameter of which, externally, is a little greater either way than that of the pan. From the middle of one of the sides of this furnace extends a broad beak or lip, inclined gradually upward from the bottom of the pan and projecting a foot beyond the furnace wall. From the opposite corners of the side to which the beak is attached project two short iron pins or gudgeons, forming the extremities of the axis of the pan upon which it turns. These enter sockets or staples securely embedded in the wall itself, or in the timbers directly outside of it. To a ring on the middle of the side opposite to that from which the beak projects a short chain is fastened and secured at its other extremity to the short arm of a lever pivoted to the head of an upright post, set in the ground a few inches in the rear of the pan. By bearing upon the long arm of the lever the whole contents of the pan may be instantly dumped into a cooler placed below the projecting beak. A damper should be arranged so as to throw the heat at any time into a lower flue, but particularly when the pan is tilted.

If steam is used to heat the finishing-pan, the use of the tilting apparatus may be dispensed with; but in this case the heat should be applied by means of a steam space underneath, or jacket, and not by a coil to prevent adhesion of the dense sirup to the pipes. In connection with this vessel a sharp-edged wooden scraper should be used, consisting simply of a board of hard wood, and of a length slightly less than the width of the pan, 4 or 5 inches in width, pierced with holes of half an inch or an inch in diameter, and attached by its middle to a handle of 3 or 4 feet in length, set at right angles to it. This instrument is to be moved back and forth on the whole bottom of the pan during the last two or three minutes of the concentration of the sirup.

THE COOLER.

The cooler into which the finishing-pan discharges may be simply a close-jointed wooden trough, broad and flat, and capable of containing the successive batches of crystallizing sugar produced during half a day's or a day's boiling. Two of the boxes should be provided to be used alternatively.

CRYSTALLIZING VESSELS.

These, as they are filled, are to be emptied into the crystallizing vessels, which may be of any convenient shape or size in which provision for drainage is secured, and which are placed in a close apartment near by, the temperature of which is kept up to about 80° to 90° F.

For experimental purposes tubs or half-barrels, with movable plugs in the bottoms, with false bottoms of slats inside and covered with coarse sacking, may be used in which to crystallize the sugar. But of a better form and scarcely more expensive are boxes 5 feet in length by 3 in breadth, the bottom formed of two planes inclined 6 inches, the intersection of which forms a groove in the middle. In this groove are twelve or fifteen holes of an inch in diameter to permit the sirup to flow out, but

temporarily closed with plugs, abruptly pointed and projecting inside 1 or 2 inches. The depth is 9 inches at the sides and 16 inches at the center. These vessels may be made of boards 1 inch thick, cemented at the joints with white lead or glycerine and litharge, and burnt out with a hot iron inside, so as to form a sloping cavity surrounding the openings for drainage. These vessels when filtered to within 3 inches of the top will hold about 75 gallons of sirup for granulation. They should be supported upon timbers above troughs connected with a cistern on a lower level, to receive the molasses as it drips from the sugar. This form of crystallizing-box originated with Dutrone la Coutusa,* one of the most eminent names connected with sugar manufacture from the Southern cane during the last century, and may still be recommended for this purpose, as combining every possible advantage in crystallizing and draining with the requisite strength. The number of these boxes that will be required will of course depend upon the amount of work to be done.

It is convenient to have the cooler mounted upon a small truck, to run from the side of the finisher into the crystallizing room where it is to be emptied.

The simple apparatus above described, together with a Baumer's sirup hydrometer and a good thermometer, which is to be immersed in a tank supplied by the heaters, is all that is indispensable for the production of a good variety of sugar from these plants by this process. Most of the machinery that is required is already in use in every State in the Union. The requirements of capital working on the large scale will necessitate the introduction ere long of that which is more expensive, but the essential features of the work on every scale of magnitude will remain the same. For it must be borne in mind that it is upon the peculiar chemical treatment of the juice that success almost entirely depends.

PROCESS OF MANUFACTURE.

It now only remains to particularize the different steps in the system to be pursued. The whole subject of the extraction of sugar from these sources is fraught with interest at every point of view. Especially is this so in regard to the peculiarities of these juices themselves. At the first view it might seem that the art of extracting sugar from liquids so rich in it as these have proved to be, ought not to be a matter of much difficulty in practice; but its apparent simplicity vanishes when it is found that the saccharine liquids constitute a distinct class by themselves, and that they contain, intimately associated with the sugar, a variety of other substances of very different chemical properties and relations. Some of them are among the most unstable of all organic bodies. Most of these substances, uncrystallizable themselves, prevent by their pressure the sugar from assuming the crystalline form, the only form in which it can be obtained pure. In order that we may make sugar, therefore, it is necessary first either to remove these extraneous substances from the saccharine solution, or by some chemical agency to change their form and characteristics, that, although present in the solution, they will present no barrier to the crystallization of the associated sugar. In this case it has been necessary to employ media operating in both these ways.

CHEMICAL MEANS EMPLOYED.

But the means used for this purpose must be well chosen. They must be adequate—they must be of such kind as to use on a large scale. The

* Quoted by McCulloch, Report, p. 286. Précis sur la Canne, p. 184. Paris, 1790.

defecating agents must be harmless to the health if inadvertently added in excess to the juice, and must leave no hurtful compounds in any product which is afterward to be used as an article of diet; they must be sufficient in quantity and low in price, and they must not exert any prejudicial influence upon the sugar itself.

In a problem of this kind nothing good can be accomplished at haphazard. A strict adherence to *system* is necessary to practical success; but it must be a system in which the means employed must be commensurate with clearly defined ends in view. Lack of information upon some of the most important points has led some persons, whom a little investigation would have taught, to adopt expensive methods of treating sorghum, borrowed from the beet and cane sugar manufacture of France and Louisiana, which in the end they have been compelled to abandon after much disappointment and loss. It is fortunate at this time that not only corn and sorghum are adapted to a single general mode of treatment, but that they do not require any considerable deviation from an established routine, provided that such due care has been observed to prevent deterioration of juice as has been already recommended.

TREATMENT OF JUICE IN THE TANKS.

The series of chemical changes produced in the juice follow the introduction into it at the proper time, and in graduated quantities, of two standard solutions, which for brevity I shall designate respectively as solutions A and B. Solution A consists principally of a very concentrated liquid saccharate of lime. It is of standard strength, and produces uniform results. In cases in which it cannot be procured during the coming season, milk of lime may be used in its place, but with the disadvantage that the strength of the mixture is extremely variable, the lime being chiefly suspended in water instead of dissolved. In preparation of it lime of the best quality should be used, carefully slacked and washed in boiling water to remove any potash that it may contain, lime in itself being but slightly soluble in hot water. After decanting the excess of water, enough is mingled with it to form, when the coarse articles have fallen to the bottom of the vessel, a mixture with a fine sediment of the consistence of thin cream.

Taking the capacity of the heating tank to be 100 gallons each between the level of a mark made on its side six inches from the top and the level of the exit cock near its bottom, we begin by filling one of the tanks up to the mark, and then turn the flow of juice from the supply-pipe into the other. One hundred gallons is a convenient measure of juice, and can be reduced to the proper density on an evaporator and finisher of moderate capacity in one hour. Heat should be applied rapidly as soon as the juice begins to enter the tank, and when it has been filled up to the mark, and the temperature of the liquid has risen to about 180°, or a point just endurable by the hand immersed in it, add to it five pints of milk of lime if the juice is that of corn, or seven pints if it is that of sorghum. Stir it thoroughly, bring up the heat to a boiling point, and then shut it off and remove quickly with a large skimmer the blanket of scum formed. Allow the liquid to rest a few minutes, to permit the suspended flocculencies to subside somewhat; without waiting, however, for this to be accomplished perfectly, commence to draw off by means of a siphon or swing pipe the upper portion of the liquid into the tank below, and finally into the lower stratum down to the muddy sediment, which may then be swept out by a large pipe at the bottom into a long bag strainer. The tank is then to be refilled as before, while its companion

is being exhausted. At this stage of the process the juice is strongly alkaline, and of a light wine color. A thermometer is kept immersed in the tank supplied by the heaters, and as soon as its temperature has fallen to 150° F., five pints of the solution B are poured into it, if it contains the contents of one of the heaters, or in that proportion.

CHEMICAL REACTIONS.

The peculiar chemical reactions induced in these juices at this stage of the process may briefly be indicated as follows: Previous to the addition of the solution to the juice, the latter had received the full benefit of the action of heat and lime, both separate and combined. Some pernicious substances are thus separated in the insoluble form, the removal of which could not so well be affected by any other means. But new compounds are formed, or are in process of formation, which would exert a still more injurious effect upon the sugars than those which they supplant. The introduction of solution B at this point arrests this action, and its effects are manifested—

1. In the preservation of sugars of both kinds from decomposition, and the production of a dark-red coloring matter, which is its visible evidence, is prevented. Hence, bone-black is entirely dispensed with.

2. The neutralization of the excess of lime is accomplished more perfectly than by the use of carbonic acid, and much more easily and cheaply. Hence, we drop carbonation, which is so essential in the beet-sugar processes.

3. The removal of the influence of a previously dissolved nitrogenous body in an insoluble form—that of caseine, associated with a peculiar fatty substance. These separate in curdy flocks, forming a broken, greasy pellicle. Without following out these changes further, at present, it may be said that separation of these substances seems to remove the last hinderances to crystallization.*

EVAPORATION.

After the removal of the characteristic scum, which forms almost as soon as the juice treated as already described is admitted into the evaporator, a great change is seen to have taken place. The juice is brilliantly transparent and of the lightest golden color. Except to take away the thin, curdy pellicle, which will still continue to be thrown off to some extent, no special care need be taken in the evaporation, except that it be conducted as rapidly as possible from a shallow bed of juice. After it has reached the condition of a not very dense sirup (as indicated by a boiling temperature of 225° F.), it is ready to be received into the finisher, as above described. This sirup should be of brightest golden hue, if it is from sorghum, and perfectly clear. If from maize, the color will generally be somewhat deeper, with sometimes a faint, pinkish tinge.

In the case of sorghum, the sirup should be concentrated in a few minutes to a point at which it suddenly becomes clouded or opalescent, and scarcely flows from a ladle dipped into it and immediately held up in the air. It boils without foam, except at the last, and during the last stages of concentration it should be constantly stirred with a scraper, already described.

*At the time these sheets go to press it would be premature to announce the chemical composition of the solution referred to. It need not be long delayed, but the present protection of the writer in the use of the substances so employed is the only reward that is secured him in these investigations.

Corn sirup should not be boiled to so great a density, but it may, without detriment, be reduced to as low a point as is indicated by a temperature, while boiling, of 236° to 239° F.

CRYSTALLIZATION.

The cooler should be capacious enough to contain the successive skippings of several hours' work. The type of the crystallization will be improved, and it will issue much more rapidly, if a very small quantity of well-crystallized sugar be mixed with the sirup as it cools. Therefore, when the cooler and crystallizing vessels are emptied each time to be refilled, it is advisable to allow some sugar to remain adherent to the bottom and sides, to form nuclei for the following batch, and it is as well to stir into the first batch made each season an ounce or two of well-crystallized sugar; but this need not be repeated.

The cooler when changed is to be run into the crystallizing-room and its contents dipped out into the proper vessels, as above described.

The crystallization of corn sugar will become perfected in from two to ten days. From this time forward it may be treated precisely as the sugar of Southern cane. It may be left to purge itself by natural drainage from the vessels in which it has granulated, or the molasses may be removed by inclosing the mush sugar in coarse muslin sacks and applying a hydraulic pressure, or, more expeditiously still, by means of a centrifugal machine, such as those now used in the refineries and in beet-sugar works.

The sirup of drainage is to be reboiled in the finisher, or evaporator and finisher combined, and treated at the close just as the original sirup. The first crystallization from corn should be about 6¾ pounds from a gallon of sirup weighing 13 pounds—total, 10 pounds. About a pound and a half of uncrystallizable sugar remains in the molasses of the second crystallization, which may be fed to stock or otherwise utilized, but the mineral salts still remaining in it render it of no value as an article of human food.

SPECIAL TREATMENT OF SORGHUM IN CRYSTALLIZATION.

Sorghum sirup should be reduced to a density that, after a lapse of from 24 to 48 hours, when kept in a warm room, it will become an almost solid mass of sugar. It requires then a special mode of treatment, the crystals being fine and held together by only a small quantity of molasses. When in this condition the mass is to be thrown into a large tub or mixing-vessel and a small quantity (about one-tenth of its volume) of a fair, thin sirup, prepared from sorghum juice of a density of about 30° Baumé, when cold, is to be poured upon it and thoroughly incorporated in it by means of a wooden stirrer.* This will bring it to the semi-fluid state, if the room in which the operation has been performed has been kept heated. The sirup dilutes the uncrystallized sugar sufficiently to render it mobile, and does not dissolve the cane-sugar. The mass may then be drained in a centrifugal, the inner drum of which is very clearly but minutely perforated and running at the highest rate of speed.

Another method which may be followed is similar to that employed in some sugar factories to extract the juice from the pulp of the beet and also to separate the saccharine matter left in the scum.

* An iron mixing-mill, constructed somewhat like the feed-hopper of a centrifugal sugar-drainer, with a revolving shaft in its center, set with long projecting teeth, may be employed in regular work.

A number of linen and coarse muslin sacks are provided, of any convenient size, but their length should be about two and one-half times their width, say 20 by 50 inches; each sack is to be about one-third filled with this sugary mixture, folded once on itself in the middle, and flattened by placing it upon a table upon a sheet-iron plate with rounded corners, a little larger on every side than the partially flattened half of the sack and its contents, the loose half being folded under. The open end of the sack may be folded twice if necessary. The plate and sack are then to be placed within a frame on the bed of a powerful screw-press, and a series of such sacks and interleaved plates laid neatly one upon another, being turned in opposite directions, and subjected to pressure, gradually applied at first, to avoid rupture of the sacks, and afterward with sufficient power to remove all the sirup and leave the sugar nearly dry. This fine dried sugar is then to be transferred without further drying to a heating-vessel and about one-tenth of its weight of pure water mixed with it. Here it is to be heated very gradually, with frequent stirring, to diffuse the heat through the mass, and when it has partially remelted and it is in the liquified state, it is to be poured finally into the crystallizing-boxes in a room heated to about 90° F., where it will form a solid mass of crystals as soon as it becomes cool. The result is a very coarse-grained, beautiful sugar of a high grade. If properly prepared, it will be almost white, and the immediate yield is almost double that which may be secured in any other way without reboiling.

The sugar prepared from sorghum in this way has the additional advantage of not being contaminated with the secondary products usually formed by reboiling; the final crystallization is attended by no risk, is easily and cheaply done, and in quality, with due care, should rank nearly or quite equal to vacuum sugar. The very small quantity of sirup left in contact with the crystals will drain off from the crystallizers, and, being almost free from glucose, will crystallize gradually if exposed in broad trays at the temperature of the room. If the production of sugar of a softer and more open grain is desired, it can readily be accomplished by a mode of treatment almost identical with the "stirring off" process adopted by maple-sugar producers, but with better results. As soon as the half-liquified sugary mass, produced as already mentioned, has been poured in the crystallizing-boxes, it should be stirred with a broad oar-shaped wooden instrument, without interruption, until it is cool and the sugar has become dry.

This method of crystallization is much better adapted to sorghum than to Indian corn, and hence I recommend the mode previously given for the latter as the best.

The general principles and specific routine, as above given, should be adhered to in all cases when the extraction of sugar from these juices is the object. It will readily be seen that they are adapted to operations of very different degrees of magnitude.

There is a large class of persons in our country having lands well adapted to sugar-growing from these sources, and possessed of sufficient energy and intelligence, whose means or opportunities do not permit them to engage largely in this pursuit, but who would be glad to have it within their power to work up the cane or corn which they could grow upon their own land; and it is just this class of persons—farmers of moderate means, desirous of enhancing their own comfort, profit, and independence—by whom the initiatory steps will be taken in this pursuit. Thousands of sets of cheap apparatus, formerly used in the manufacture of crude sorghum sirup, are now scattered over the whole country in the

possession of persons of this class. With but slight modification, this machinery can now be utilized in the experiment of the production of crude maize and sorghum sugars. The process is sufficiently simple as above defined to make this clearly practicable without expense.

The growth of this new branch of industry will soon give rise to large establishments in many places, supplanting, to some extent, more limited individual operations; yet it must be conceded that it is with the latter just now that this enterprise more particularly is to be identified. From the circumstance that the means are already provided for success in this stage of the work, the value of the time and money gained by putting them to an immediate practical use is almost beyond estimate.

It was only after many years of trial of mills propelled by animal power, and of inexpensive apparatus, that the sugar industry of Louisiana ever attained to any prominence, and, notwithstanding the most elaborate and expensive machinery has of late years been in use there, small planters still adhere to the simpler appliances, and with a very marked degree of success and profit. Here, also, large works will not interfere in the least with those conducted on a very moderate scale, if the latter be managed with skill and prudence. The one mill will be auxiliary to the other. In fact, the expense of transporting large quantities of canes from different parts of an extended area of country to one central manufactory is a source of great loss in many respects, and there is constant risk of deterioration by the delay which is scarcely balanced by advantages accruing from a concentration of capital and skill.

The question is asked, how can a planter work up to advantage a crop of from ten to twenty acres of cane or corn on his own land and under his own care, conducting the whole series of operations, beginning with the working of the soil and the planting of the seed, and ending with the production of a good article of crude, yellow sugar?

The importance of this question demands an answer in more explicit terms than is found in the general outline already given. In the accompanying diagram the essential features of a sugar factory to answer such a purpose are sketched. It is most convenient to have the whole work done under one roof, or within a single building. Where the location admits of it, the general arrangement here given will be found to be very advantageous. But whatever be the shape or size of the building, it is necessary that the space inside should be divided off into four separate compartments, and these should be contiguous to each other in the following order: (*A*) The mill-room; (*B*) the evaporating-room; (*D*) the drying room. (See diagram.) The first two of them may be open sheds, but the last two of them should be tightly closed in, and provided with the means of keeping up the temperature within them to 80° F., whenever necessary. In addition to these there should be space for the storage of the products of the factory.

The mill (A) may be propelled by steam, water, or animal power, and, in any case, should be placed upon a strong platform of plank, supported by stout timbers. If horses are used to propel it, they work on the ground-floor below. The sweep is a straight beam, secured in a horizontal position, at a height suitable for easy draught, to a vertical wooden shaft of ten or twelve inches in diameter, which is strongly coupled to the shaft of the driving-roll. Mills with either horizontal or vertical rolls may be used in this manner.

The convenience of this arrangement is obvious. The horses work to good advantage, and the vicinity of the mill is clear of all encumbrance, and the loss by dirt, waste, and damage to machinery, &c., is much diminished. The horizontal mills should be furnished with aprons for carrying

forward the cane and removing the trash. There is room at one side and sufficient elevation to allow the latter to be dumped over the platform outside the building, either into wagons or carts, to convey it to a barn-yard for conversion into manure, or it may be utilized by burning it in the furnaces close alongside. It is convenient to have the mill-room at the base of a slight declivity or platform of rising ground, so that its floor will be on a level with the ground at the side where the cane is received to be passed through the mill.

The supply of cane or corn to the mill should be continuous. As already indicated, it should be conveyed to the mill as soon as it is cut down in the field, so that only a few hours may intervene until it is worked up. Store-room need only be provided for as much as can be passed through the mill in 24 hours. The mill, horses, cane, and all the machinery should be under roof, and there need be no interruption of the work.

From the tank at the mill (4) fall for the juice is secured. It is received first into the heating-tanks (6) by a pipe (*pp*), and thence by its downward flow successively into the defecation tank (7), the supply tank (8), the evaporator (9), the finisher (10), and the cooler (11). Thence the cooler containing the granulating-sirup is conveyed along a tramway into the crystallizing-room adjoining, and the crystallizing-boxes (*c*, *c*, *c*) are filled in succession from it. Centrifugal for drying the sugar (16) (16) or the press (17) are located in the adjoining room. Brick, lime, and cemented cisterns (18) (18) (18), excavated beneath the floor of the evaporating-room, receive through pipes or troughs the sirup of drainage from the crystallizing vessels, the centrifugal, or the press. In the drying-room (D) sufficient space may be provided for the cutting from the cob by machinery and the drying (14, 15) of the grain of sugar-corn.

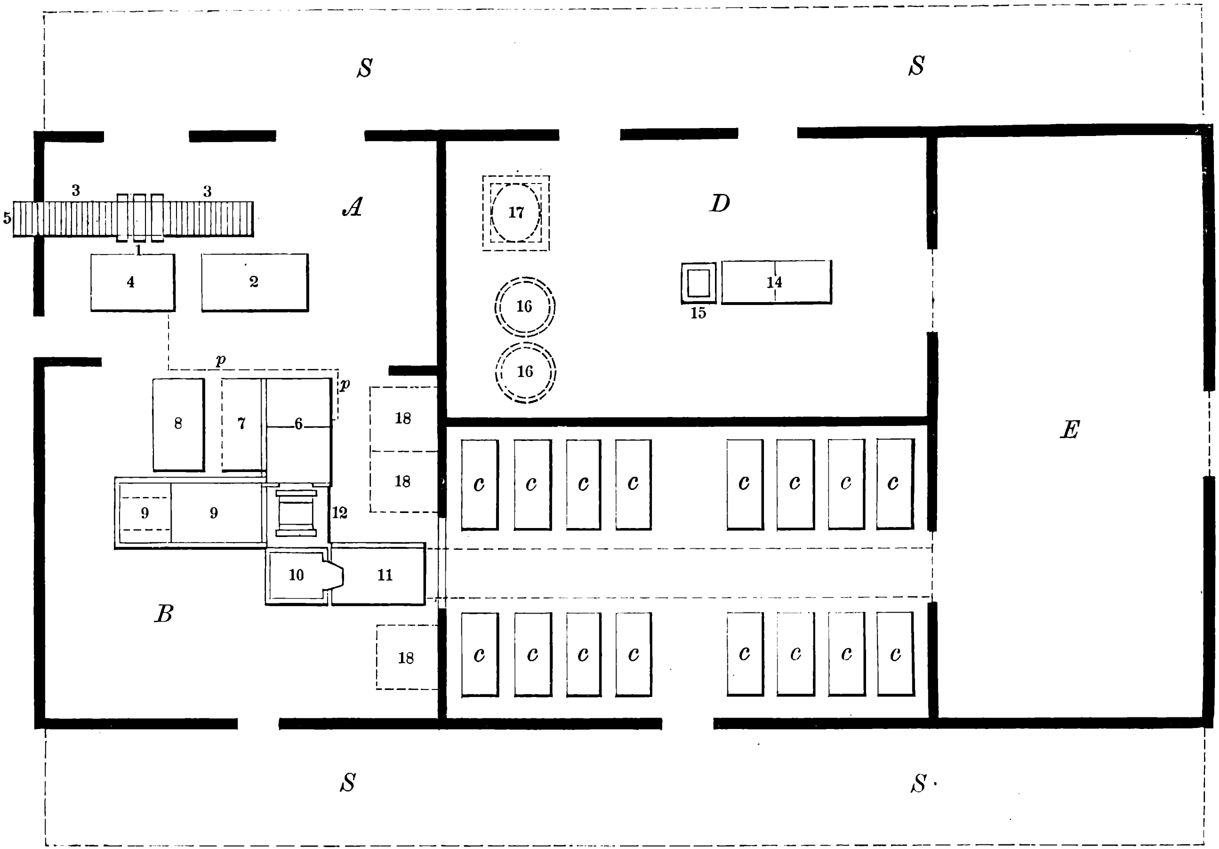
The water supply for the works should be abundant. If an engine be used to propel the crushing-mill the boilers should be sufficiently large to supply steam for evaporative or heating purposes where furnaces are employed when animal power is used.

A few observations which have not found a place in the preceding pages will conclude this paper.

Corn stems evaporate their juices very rapidly after they are cut, and if they have not been bladed previous to being cut from the ground the evaporation, as shown by test experiments made during last summer, equalled 25 per cent. of the weight of the stem when exposed to the sun and air during a period of 24 hours. This was not attended by a corresponding increase in the juice, and is a source of great loss independent of that which occurs at the same time from the transformation of crystallizable into uncrystallizable sugar. This shows that the rule should be made imperative to *work up the crop as it can be cut and brought in from the field.* It is true that when the stripped stems of either corn or cane are kept under shelter after being cut, the evaporation is much less (5½ per cent. of the weight of Kansas corn and 3½ per cent. of Chinese cane in an experiment made), and the density of the juice of both during many successive days is increased in direct proportion to the loss of water by evaporation; but it is also true that the quantity of sugar crystallizable is steadily diminished. No protection that can be given will prevent great loss if this rule be not rigidly adhered to.

It is a peculiarity of common corn, under some circumstances, that when it is allowed to stand uncut in the field after the grain has hardened, it does not lose its juice as it does generally at that period, but it is as entirely destitute of sugar as is the dried stalk in mid-winter.

There is a gradual advance in the strength of the juice of corn from



Plan of Sugar Works, of moderate size, for Sorghum and Maize.

the time of flowering until the first ear begins to harden; and in case of stems which bear two or three ears, the juice remains in proper condition while the successive ears are hardening. Hence we have an additional reason why seed for planting should be selected from double or triple eared stems.

The variety of sweet corn known as "Stowell's Evergreen" exhibits characteristics which give it marked prominence. The peculiar succulence both of the stem and grain, and the great length comparatively of the period while the ear remains in the green state, and the saccharine qualities of the juice continue unimpaired, enhance its value in this connection. At that stage of its growth when it is just "coming into roasting-ear," its juice is stronger than that of other corn, as far as tested. Generally not less than two, and often three, well-developed ears are borne upon each stalk. Although it is the latest in coming to maturity of the "sweet" varieties, it is the best "drying corn" grown, and its short, stout stalks yield as much juice as taller-stemmed sorts, and they are easier handled.

ANALYSIS OF DRIED SUGAR-CORN.

Samples taken of the immature grain of Stowell's evergreen sugar-corn, prepared (August, 1877) from it when in proper edible condition, boiling the corn in the ear for about five minutes, cutting it from the cob with a sharp knife, and drying it as rapidly as possible upon metallic plates at a regulated temperature (about 225° Fahrenheit). For the purpose of comparison, I append recent analysis of the mature grain of Pennsylvania yellow corn, made by Dr. William McMurtrie, chemist of the Department of Agriculture, and published in the Annual Report for 1873, page 178.

	Dried sugar-corn (green).	Pennsylvania yellow (mature).
Moisture	7.12	8.87
Oil	4.20	5.17
Sugar	3.52	1.10
Gum	42.52	1.23
Starch	35.50	70.66
Albuminoids and gluten*	3.02	9.92
Cellulose	2.62	1.72
Ash	1.50	1.33
	100.00	100.00

It will be seen that the proportion of these substances in the dried sugar-corn is not quite equal to that contained in the ripened yellow corn, but this difference is due chiefly to the loss of gluten (diastase) occasioned by the cutting off of the germinal point of the grain of the green corn, nearly one-third of its substance, in the usual process of preparing it for drying. This circumstance, taken in connection with the fact that the cob of the green corn is exceedingly rich in saccharine matter, gum, &c., indicates the very high value of the cob with the adherent portion of the grain for stock-feeding purposes. The pith of the green corn is large, solid, and rich in sugar and gum. I regret that I am not prepared, at this time, to furnish an analysis of the cob in this condition.

The fatty matter or oil in the dried sugar-corn is about equal to that in the matured specimens of corn generally, especially in the white varieties, although it is less than in the yellow corn, with which it is here more directly compared. The saccharine matter is much greater than in the latter, and by the application of the proper chemical tests it is found to be almost entirely crystallizable. The sugar of the grain of ripened corn is generally glucose.

* For convenience, the azotized substances are here classed together.

The most marked peculiarity of desiccated sugar-corn is the very large proportion of gummy matter which it contains (gum and dextrine) as compared with that of true starch.

Taken altogether this substance, as an article of human food, exhibits peculiarities not found in any other grain, and properly prepared it is light, rich, nutritive, and easily digested.

The proper utilization of the various secondary products arising from this industry is a subject of immense importance. This subject, in its relations to the feeding of farm stock in a systematic way, demands special attention. In these pages but one mode of utilizing the green corn is indicated; but a wide field is opened for the discovery of perhaps still more valuable modes.

In this manufacture nothing whatever should be wasted. The scums and precipitates, the washings of the sacks and of the vessels used, should be exhausted of the sugar which they contain, by reboiling and skimming, or straining and condensation to sirup for crystallization.

The rule always adopted in all well-regulated sugar-works should be enforced here. No inferior saccharine solution should ever be mixed with another of a higher grade.

The careful farmer will appreciate the importance of preserving in the best condition the top, blades, cane-seed, &c., removed in the field. The cobs from which seed-corn is cut for drying are as saccharine as the stalk, and much more nutritive. They should be fed to cattle and hogs, and cannot fail, especially in connection with other feed, to be highly valued. The bagasse, ashes of the furnaces, lime precipitates, &c., are best utilized as manures, and for this purpose they are invaluable.

Ordinary good judgment on the part of the operator, attention to details, a knowledge of the main principles involved, and a degree of practical skill easily acquired, are all that are necessary to give this new business a rapid and permanent success.

THE ROCKY MOUNTAIN LOCUST, OR GRASSHOPPER OF THE WEST.

ITS HABITS AND NATURAL HISTORY, AND THE BEST MEANS OF COUNTERACTING ITS INJURIES.

[Many inquiries come to the department for the Report of the United States Entomological Commission on the destructive locust of the West, and as but 5,000 copies have been ordered printed by Congress, we gladly avail ourselves, with the consent of the Commission, of the opportunity of reproducing parts of Chapter VIII and the whole of Chapter XIII of the work, in order to more fully disseminate the useful information they contain. A few additions have been made by Professor RILEY, and the accompanying map, reduced from one prepared by the Commission, will explain the three divisions made of the locust country, which are frequently referred to.]

HABITS AND NATURAL HISTORY.

Numerous original observations on the habits and natural history, on the transformations and on the enemies of the Rocky Mountain locust, have been recorded in Mr. Riley's last three entomological reports to the State of Missouri, in our second bulletin, which was largely prepared


MAP
SHOWING THE DISTRIBUTION,
PERMANENT AND SUBPERMANENT
BREEDING GROUNDS
OF, AND
REGION PERIODICALLY VISITED
BY THE
ROCKY MOUNTAIN LOCUST.
(Caloptenus Spretus.)
REDUCED FROM ONE PREPARED BY THE
U. S. ENTOMOLOGICAL COMMISSION.
PERMANENT REGION, or Native Breeding Grounds, where the Species is always found in greater or less abundance.
SUBPERMANENT REGION, which the Species frequently invades, in which it can perpetuate itself for several years, but from which in time it disappears.
TEMPORARY REGION, or that only periodically visited, and from which the Species generally disappears within a year.
HUDSON BAY
JAMES BAY
LAKE ATHABASCA
WINIPEG L.
SUPERIOR
San Francisco
Salt Lake City
Omaha
Leavenworth
St Louis
Springfield
Chicago
Milwaukee
Detroit
Toronto
Quebec
Halifax
Portland
Memphis
Nashville
Atlanta
Charleston
Savannah
Montgomery
Jackson
Mobile
New Orleans
Galveston
Dallas
Jacksonville
Cape Hatteras
Cape May
Rio Grande

EXPLANATIONS TO PLATES.

(Paper on "Rocky Mountain Locusts.")

EXPLANATION TO PLATE I.

FIG. 1.—ROCKY MOUNTAIN LOCUST: *a, a, a*, female in different positions, ovipositing; *b*, egg-pod extracted from ground, with the end broken open; *c*, a few eggs lying loose on the ground; *d, e*, show the earth partially removed, to illustrate an egg-mass already in place and one being placed; *f*, shows where such a mass has been covered up. (After Riley.)

FIG. 2.—ROCKY MOUNTAIN LOCUST: Anal characters of female, showing horny valves. (After Riley.)

FIG. 3.—ROCKY MOUNTAIN LOCUST: Enlarged end of body of female, showing the method of oviposition; *j*, the oviduct; *g*, the egg-guide, and egg issuing from horny valves. (After Riley.)

FIG. 4.—EGG OF ROCKY MOUNTAIN LOCUST: *a*, showing sculpture of outer shell; *b*, the same, very highly magnified; *c*, the inner shell, just before hatching. (After Riley.)

FIG. 5.—EGG-MASS OF ROCKY MOUNTAIN LOCUST: *a*, from the side, within burrow; *b*, from beneath; *c*, from above, enlarged. (After Riley.)

FIG. 6.—THE DRUM LOCUST-CRUSHER: Plan view.

FIG. 7.—THE DRUM LOCUST-CRUSHER: Vertical section.

EXPLANATION TO PLATE II.

FIG. 1.—THE SIMPSON LOCUST-CRUSHER: Perspective view.

FIG. 2.—THE SIMPSON LOCUST-CRUSHER: Sectional view.

FIG. 3.—THE SIMPSON LOCUST-CRUSHER: Sectional view, when ready to remove the insects.

FIG. 4.—THE HOOS LOCUST-CRUSHER: Top view.

FIG. 5.—THE HOOS LOCUST-CRUSHER: Vertical section.

EXPLANATION TO PLATE III.

FIG. 1.—THE HOOS LOCUST-CRUSHER: Side view.

FIG. 2.—THE HANSBERRY LOCUST-CRUSHER: Top view.

FIG. 3.—THE HANSBERRY LOCUST-CRUSHER: Front view.

FIG. 4.—THE HANSBERRY LOCUST-CRUSHER: Sectional view.

FIG. 5.—THE HANSBERRY LOCUST-CRUSHER: Slide attachment.

FIG. 6.—THE KENWORTHY LOCUST-MACHINE: Plan view.

FIG. 7.—THE KENWORTHY LOCUST-MACHINE: Side view.

FIG. 8.—LARGE OIL-PAN.

EXPLANATION TO PLATE IV.

FIG. 1.—THE PETELER LOCUST-CRUSHING MACHINE: Front view.

EXPLANATION TO PLATE V.

FIG. 1.—THE PETELER LOCUST-CRUSHING MACHINE: Side view.

FIG. 2.—THE KING SUCTION-MACHINE: Front view.

EXPLANATION TO PLATE VI.

FIG. 1.—THE KING SUCTION-MACHINE: Side view, in operation.

EXPLANATION TO PLATE VII.

FIG. 1.—THE CANFIELD COAL-OIL PAN: Perspective view.

FIG. 2.—THE CANFIELD COAL-OIL PAN: Longitudinal view.

FIG. 3.—THE ADAMS LOCUST-PAN.

EXPLANATION TO PLATE VIII.

FIG. 1.—THE PRICE OIL-PAN.

FIG. 2.—SIMPLE COAL-OIL PAN.

FIG. 3.—THE ANDERSON COAL-OIL CONTRIVANCE.

EXPLANATION TO PLATE IX.

FIG. 1.—THE ROBBINS COAL-TAR PAN.

FIG. 2.—THE FLORY LOCUST-MACHINE: Front view, in operation.

FIG. 3.—THE FLORY LOCUST-MACHINE: Side view of frame.

EXPLANATION TO PLATE X.

FIG. 1.—THE RILEY LOCUST-CATCHER.

EXPLANATION TO PLATE XI.

FIG. 1.—THE WILSON-RHODE LOCUST-CATCHER: Side view.

FIG. 2.—THE WILSON-RHODE LOCUST-CATCHER: Top view.

FIG. 3.—THE GODARD LOCUST-CATCHER: Plan view.

FIG. 4.—THE GODARD LOCUST-CATCHER: Vertical section.

FIG. 5.—THE GODARD LOCUST-CATCHER: End view of frame.

FIG. 6.—THE BENSON LOCUST-CATCHER: Plan view.

FIG. 7.—THE BENSON LOCUST-CATCHER: Vertical section.

EXPLANATION TO PLATE XII.

FIG. 1.—THE HUTCHINS LOCUST-CATCHER: Top view.

FIG. 2.—THE HUTCHINS LOCUST-CATCHER: Sectional view.

FIG. 3.—THE SYLVESTER LOCUST-CATCHER.

FIG. 4.—HAND-NET: *a*, complete; *b*, hollow handle; *c*, bent frame.

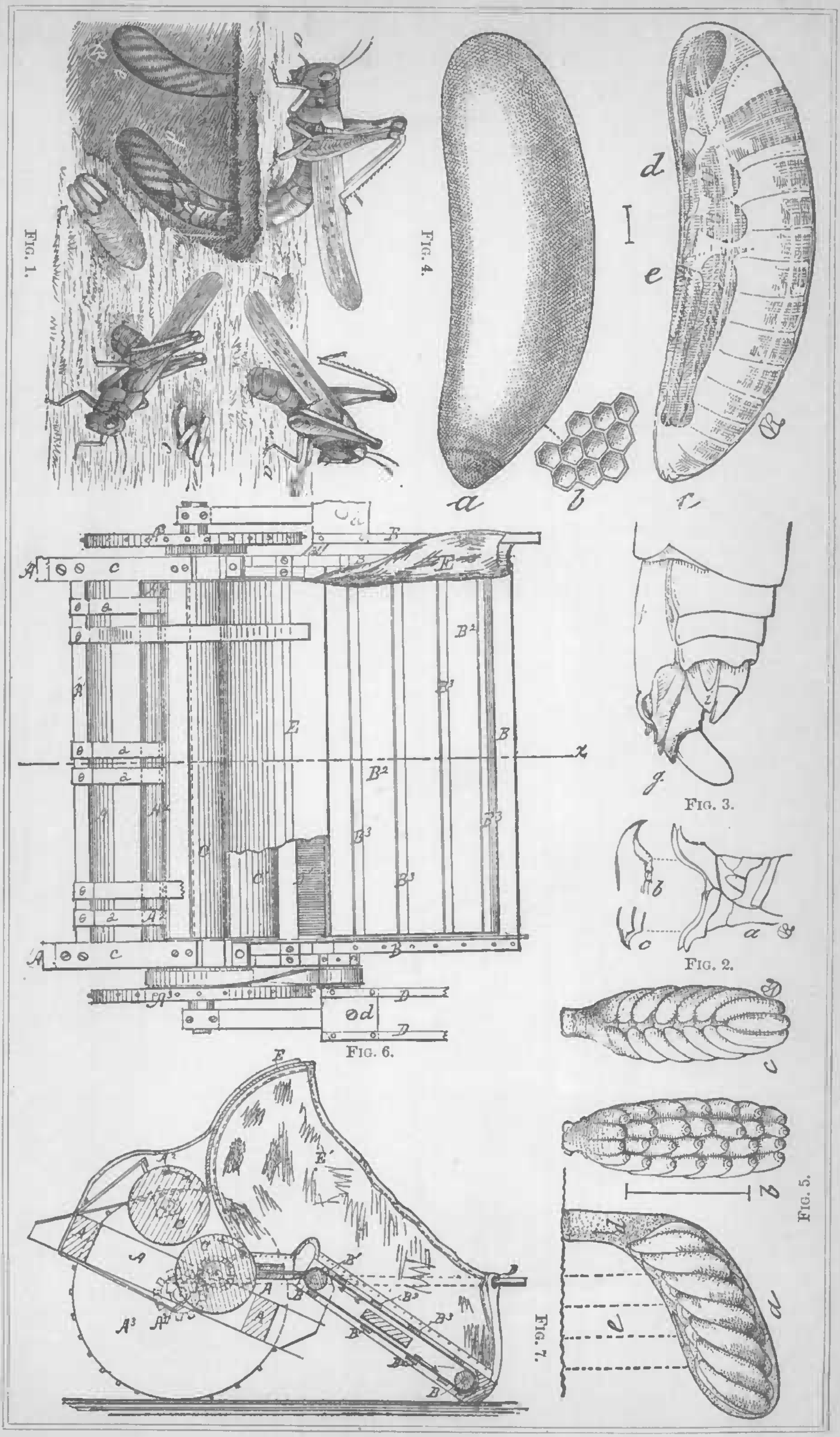
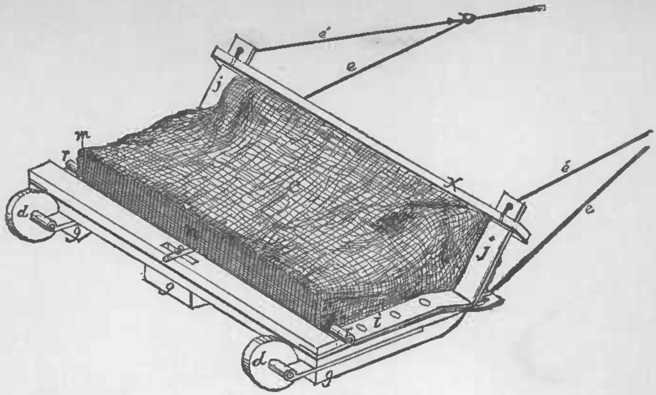


Fig. 1. Fig. 2. Fig. 3. Fig. 4. Fig. 5. Fig. 6. Fig. 7.



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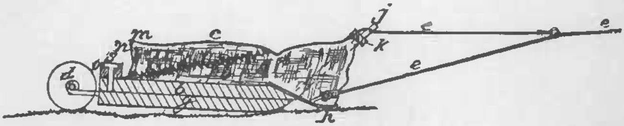

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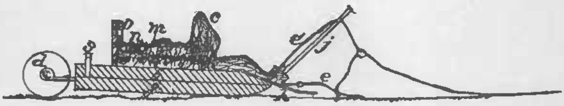

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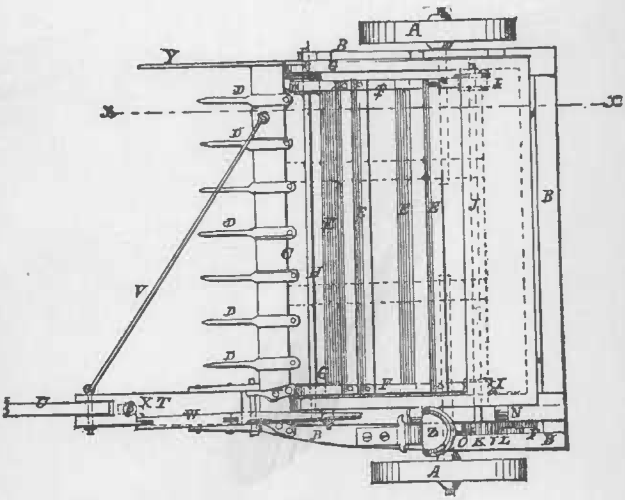

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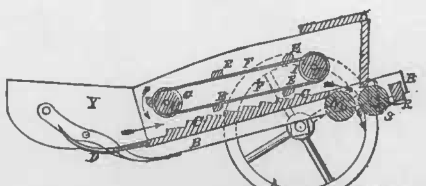

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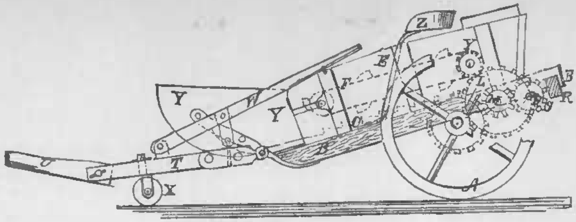

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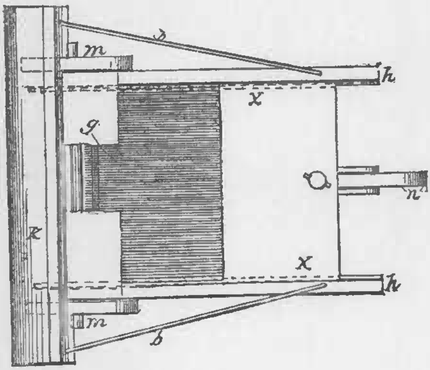

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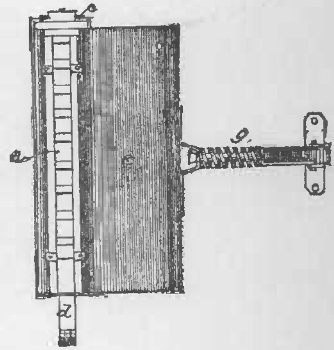

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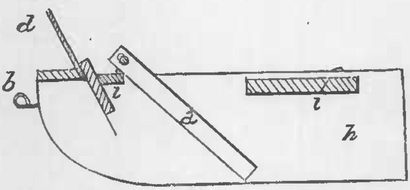

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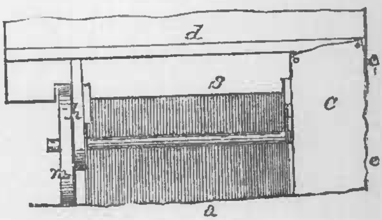

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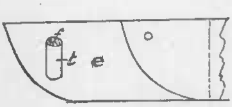

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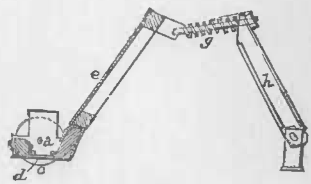


FIG. 7.

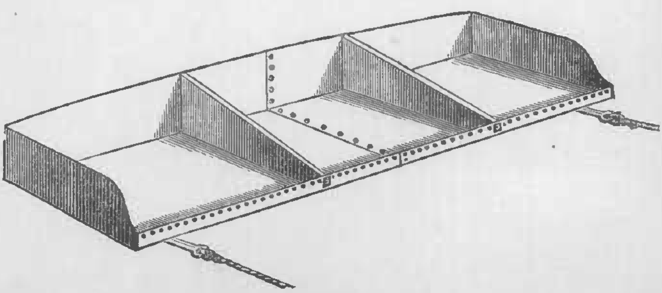
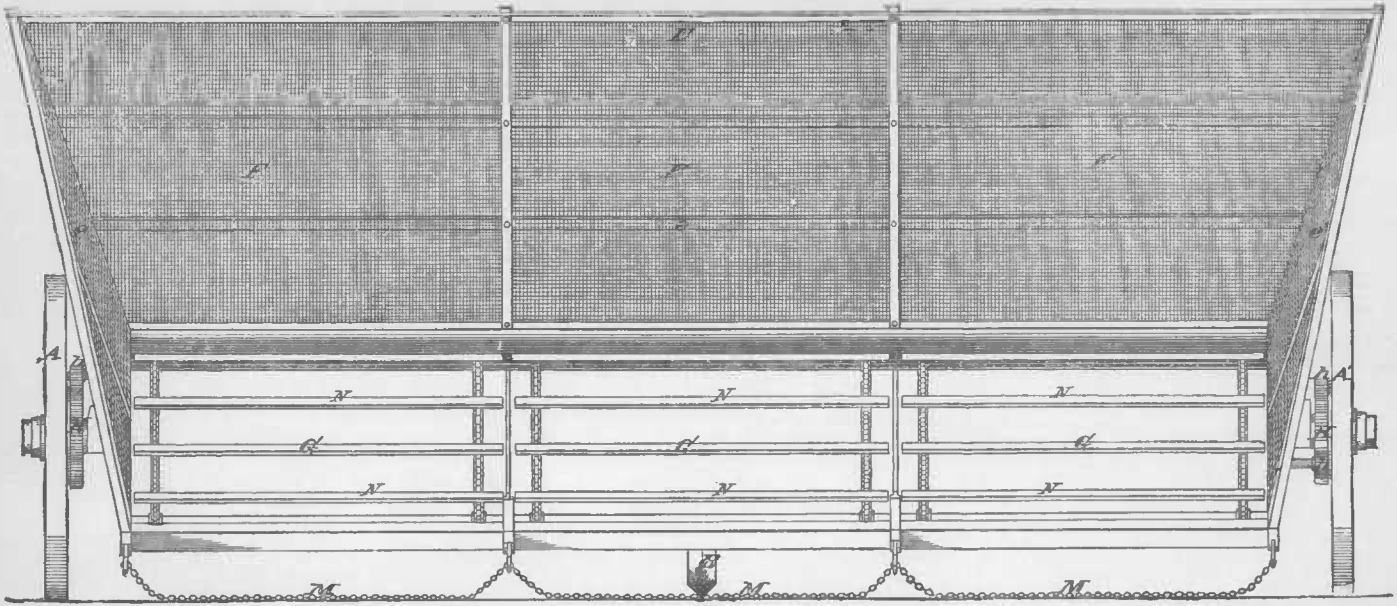


FIG. 8.

Plate IV.



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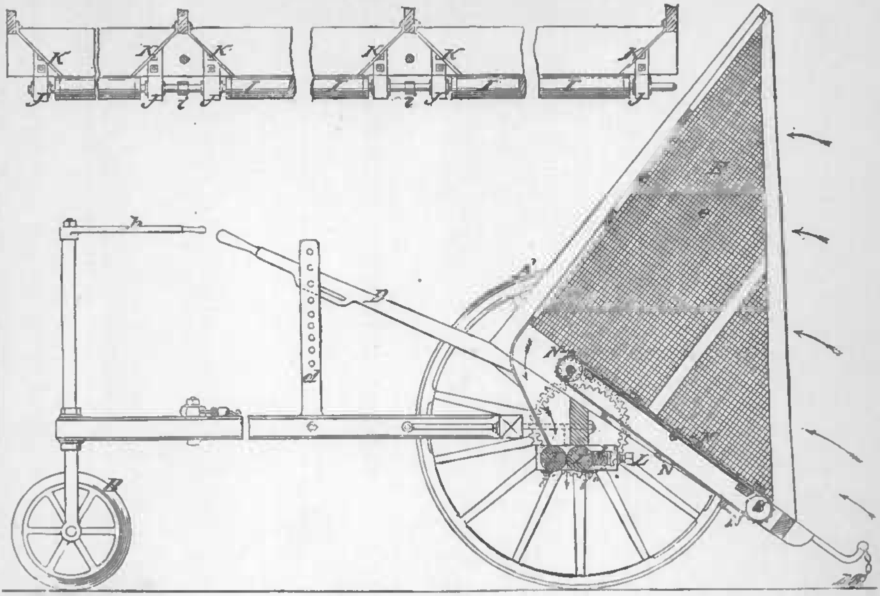

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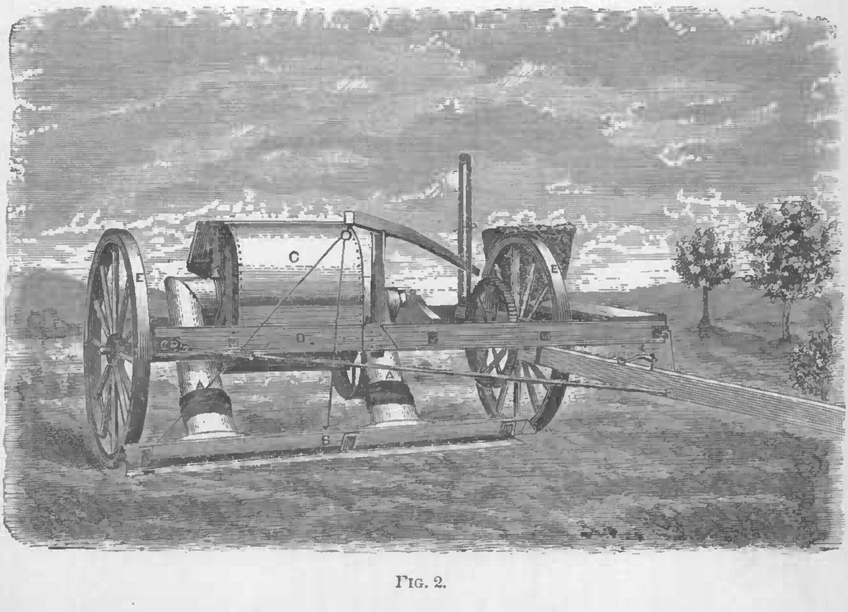


FIG. 2.

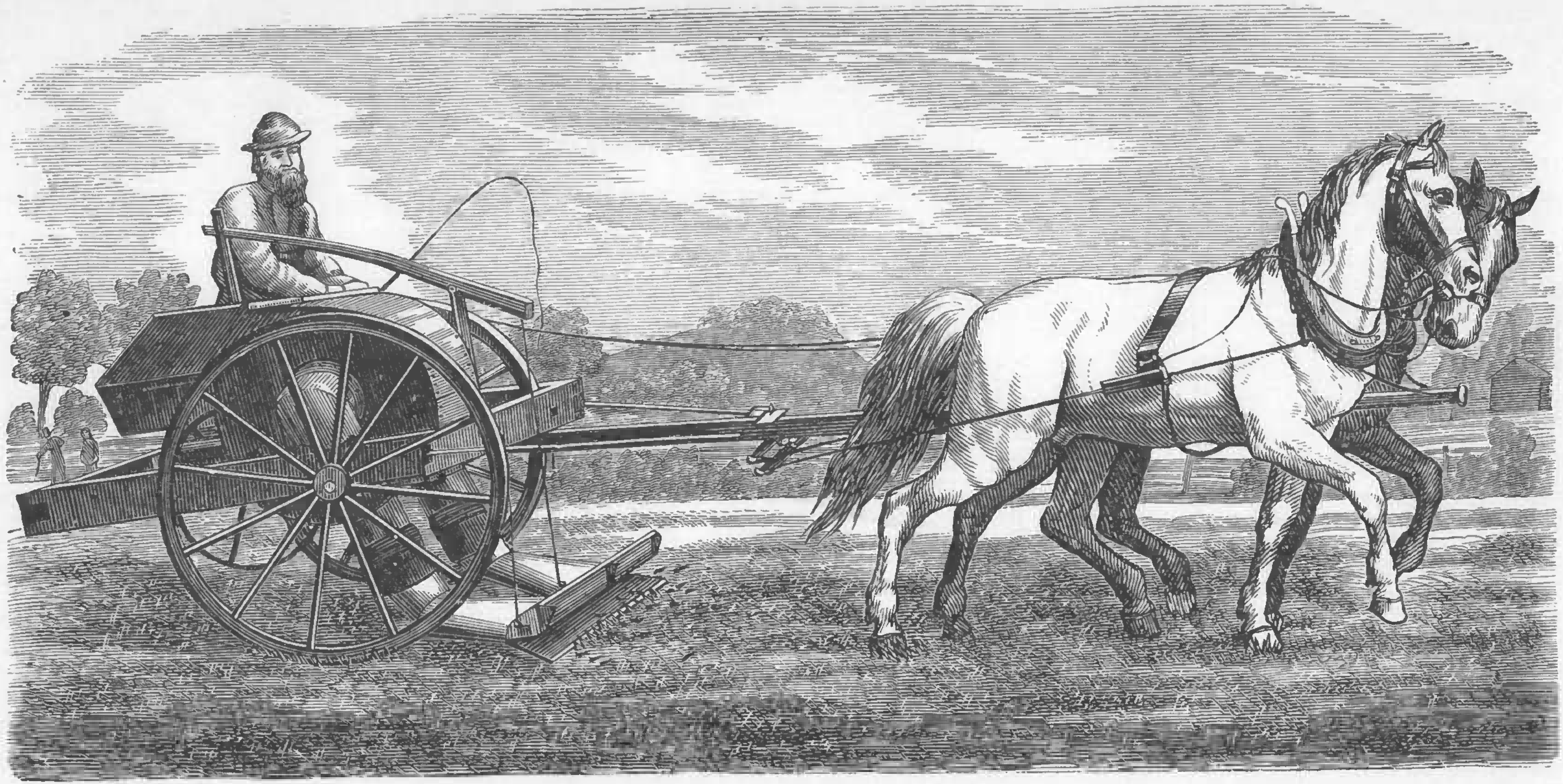


FIG. 1.

Plate VII.

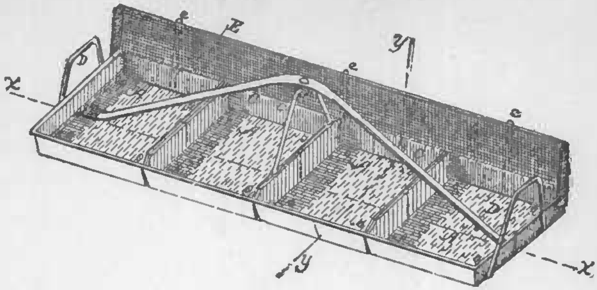
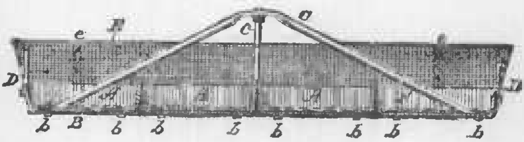


FIG. 1.



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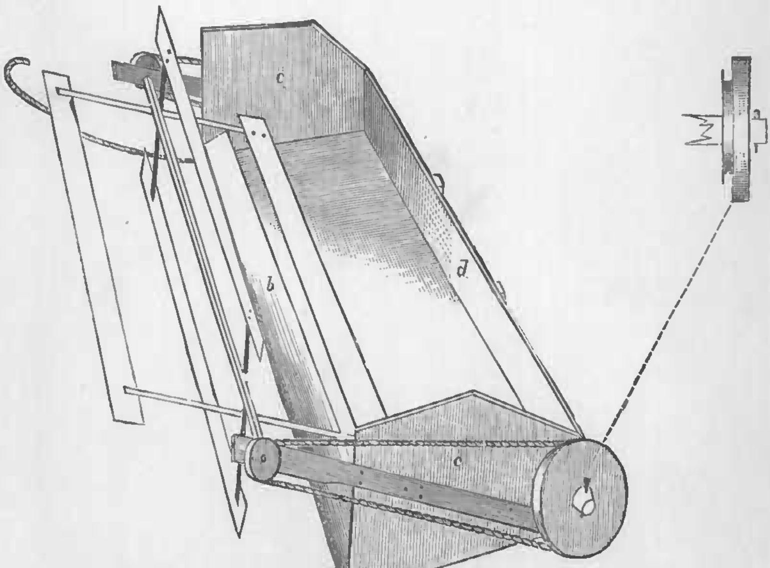

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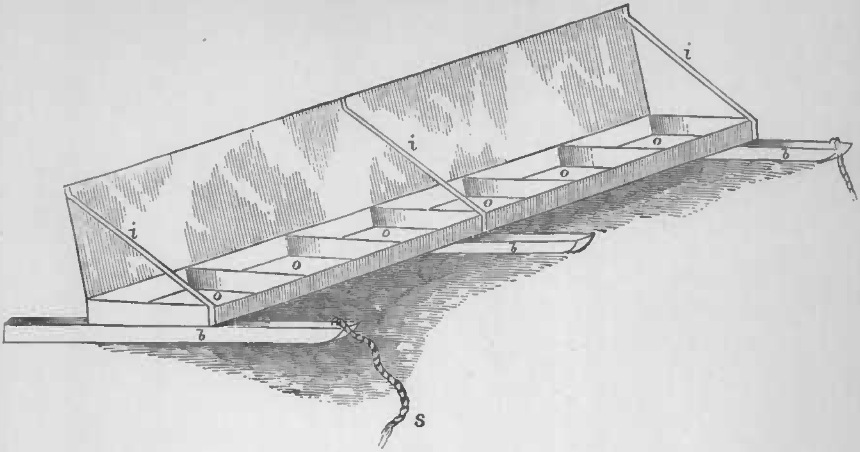

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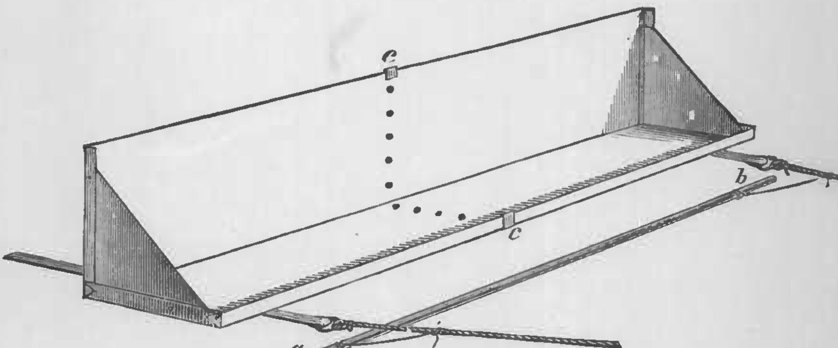
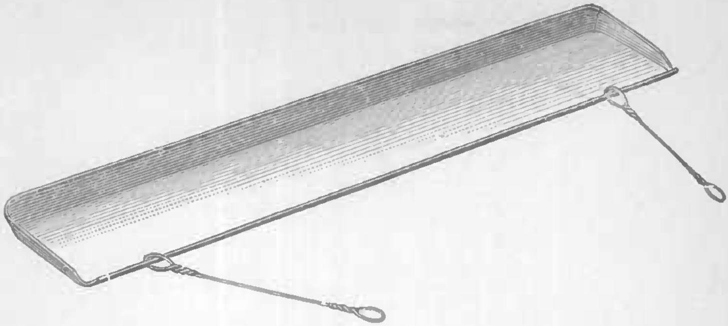


Fig. 2.

Fig. 3.



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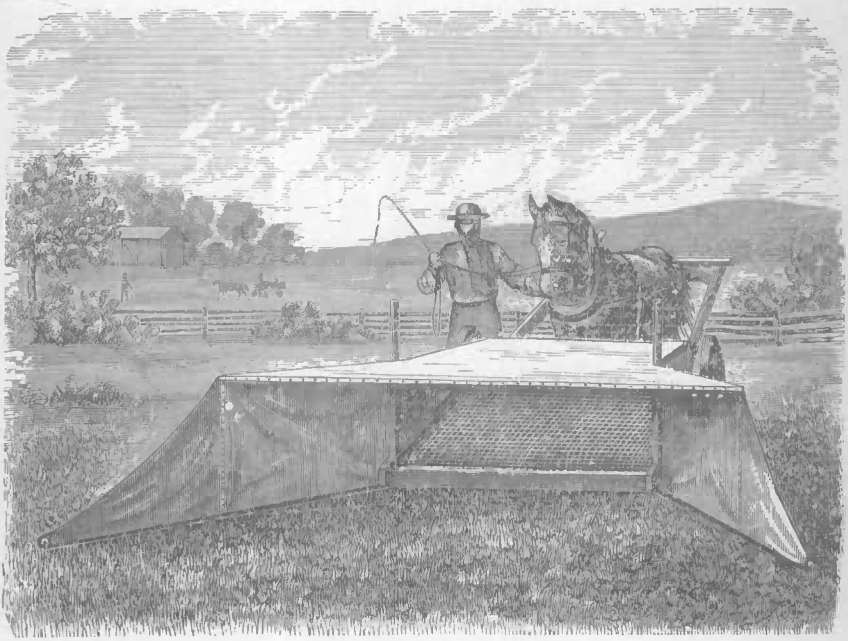

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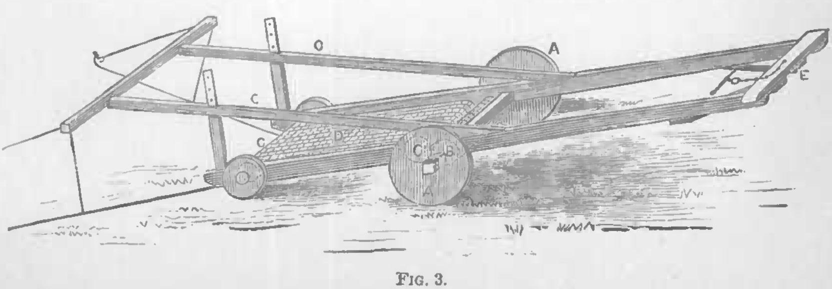
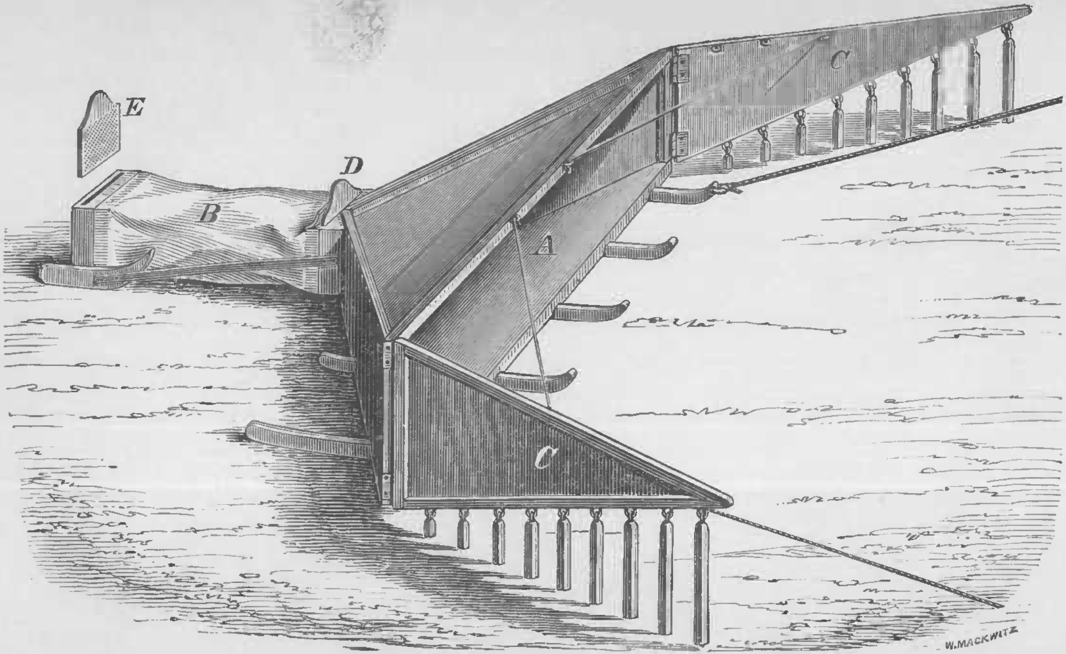


Fig. 3.

Plate X.



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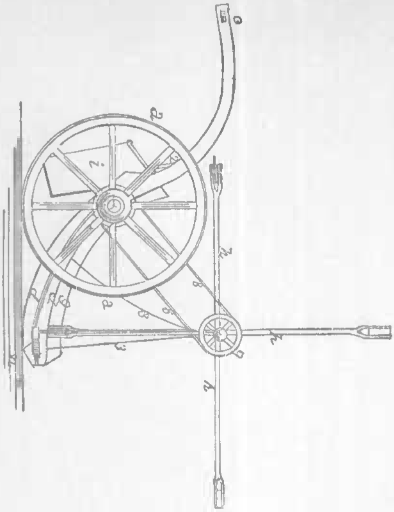
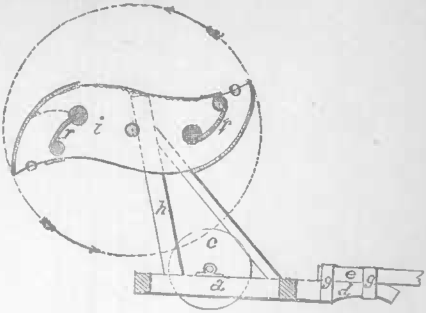


FIG. 1.



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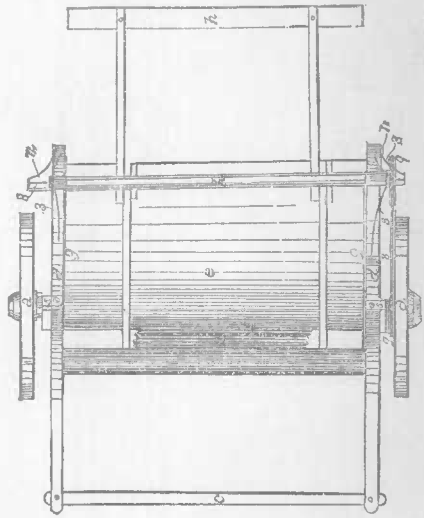

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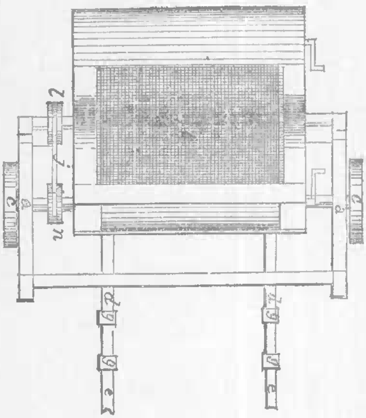

FIG. 3.

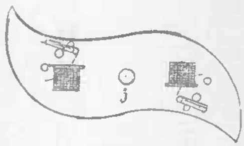

FIG. 5.

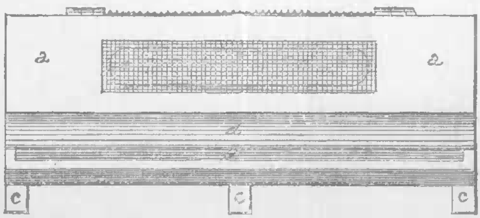

FIG. 6.

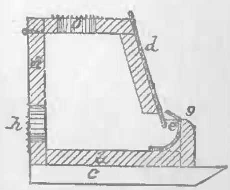

FIG. 7.

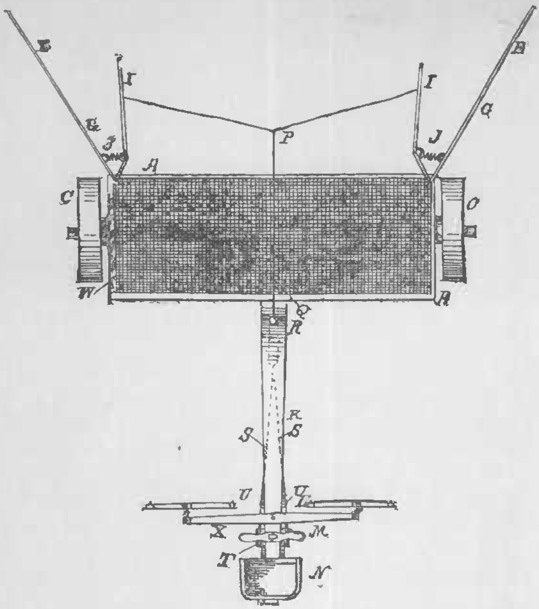

FIG. 1.

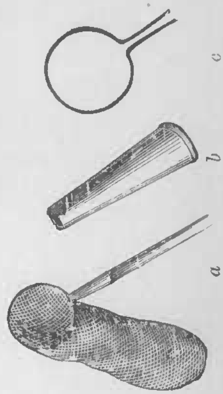

FIG. 4.

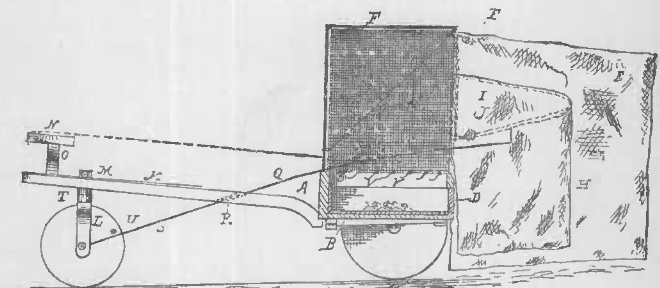

FIG. 2.

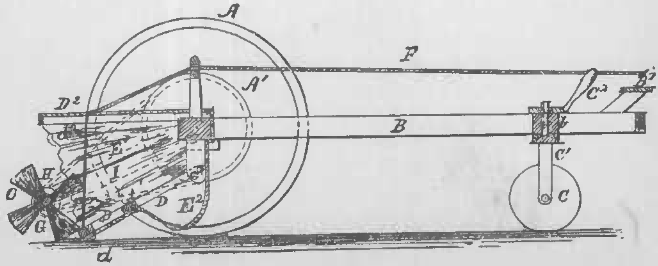

FIG. 3.

therefrom, and in his "Locust Plague in the United States," as well as in other publications. In this and some of the succeeding chapters we shall have frequent occasion to use these facts, and prefer to do so as far as possible in the language in which they were originally recorded; but to avoid repeated reference to the same works, we shall simply use quotation marks, and the reader will understand that where other authority is not given, passages in quotation marks are from said writings. We do this the more readily that the Missouri reports are with difficulty obtained, and have had but a very limited circulation outside the State.

In treating of the habits of this insect we must needs do so from our own as well as the general experience; and since this has been almost entirely in the Mississippi Valley, the facts and generalizations that follow should be understood as applying more particularly to this region. We shall also have frequent occasion to use the terms *Permanent*, *Subpermanent*, and *Temporary* regions, that have already been explained (pp. 131–6), and are set forth in map 1. In treating of the habits and natural history of this insect, one thing has more particularly impressed us, viz., the difficulty of making absolute statements that will cover all seasons and all localities. The insect is so variable in its habits, and the conditions of climate and plant-growth are so different in different parts of the country affected, that what applies in one year or to one section will not apply in all years or to all sections. Hence the necessity of the regional classification just referred to, and the difficulty of laying down rules that have not exceptions.

DESTRUCTIVE POWER OF LOCUSTS.

No one who has not witnessed the ravaging power of locusts can fully conceive of or appreciate it. The organization and habit of the typical locust admirably fit it for ravenous work. Muscular, gregarious, with powerful jaws, and ample digestive and reproductive systems; strong of wing and assisted in flight by numerous air-sacs that buoy—all these traits conspire to make it the terrible engine of destruction which history shows it to have been under conditions favorable to its excessive multiplication. Insignificant individually, but mighty collectively, locusts fall upon a country like a plague or a blight. The farmer plows and plants. He cultivates in hope, watching his growing grain, in graceful, wave-like motion wafted to and fro by the warm summer winds. The green begins to golden; the harvest is at hand. Joy lightens his labor as the fruit of past toil is about to be realized. The day breaks with a smiling sun that sends his ripening rays through laden orchards and promising fields. Kine and stock of every sort are sleek with plenty, and all the earth seems glad. The day grows. Suddenly the sun's face is darkened, and clouds obscure the sky. The joy of the morn gives way to ominous fear. The day closes, and ravenous locust-swarms have fallen upon the land. The morrow comes, and, ah! what a change it brings! The fertile land of promise and plenty has become a desolate waste, and old Sol, even at his brightest, shines sadly through an atmosphere alive with myriads of glittering insects. The suffering in the country invaded in 1874, and the dreadful desolation the following spring, are sufficiently fresh in the minds of Western farmers, while the details given in Chapter III convey a fair idea of the magnitude of the loss inflicted.

Falling upon a cornfield, the insects convert in a few hours the green and promising acres into a desolate stretch of bare, spindling stalks and stubs. "Covering each hill by hundreds; scrambling from row to row like a lot of young famished pigs let out to their trough; insignificant individually, but mighty collectively, they sweep clean a field

quicker than would a whole herd of hungry steers. Imagine hundreds of square miles covered with such a ravenous horde, and one can get some realization of the picture presented in many parts of the country west of the Mississippi during years of locust invasion.

"Their flight may be likened to an immense snow-storm, extending from the ground to a height at which our visual organs perceive them only as minute, darting scintillations, leaving the imagination to picture them indefinite distances beyond. 'When on the highest peaks of the Snowy Range, fourteen or fifteen thousand feet above the sea, I have seen them filling the air as much higher as they could be distinguished with a good field-glass.'* It is a vast cloud of animated specks, glittering against the sun. On the horizon they often appear as a dust tornado, riding upon the wind like an ominous hail-storm, eddying and whirling about like the wild, dead leaves in an autumn storm, and finally sweeping up to and past you, with a power that is irresistible. They move mainly with the wind, and when there is no wind they whirl about in the air like swarming bees. If a passing swarm suddenly meets with a change in the atmosphere, 'such as the approach of a thunder-storm or gale of wind, they come down precipitately, seeming to fold their wings, and fall by the force of gravity, thousands being killed by the fall if it is upon stone or other hard surface.'"†

An idea of the vast numbers that will sometimes descend to the ground may be formed by the following occurrence, related to us by an intelligent and reliable eye-witness, Mr. H. McAllister, of Colorado Springs, Colo.: In 1875, early in August, a swarm suddenly came down at that place. The insects came with the wind, and alighted in a rain. The ground was literally covered two and three inches deep, and glittered "as a new dollar" with the active multitude. In rising, the next day, by a common impulse, their wings would get entangled, and they would drop to the ground again in a matted mass. "In alighting, they circle in myriads about you, beating against everything animate or inanimate, driving into open doors and windows, heaping about your feet and around your buildings, their jaws constantly at work biting and testing all things in seeking what they can devour. In the midst of the incessant buzz and noise which such a flight produces, in face of the unavoidable destruction everywhere going on, one is bewildered and awed at the collective power of the ravaging host, which calls to mind so forcibly the plagues of Egypt.

"The noise their myriad jaws make when engaged in their work of destruction can be realized by any one who has 'fought' a prairie fire or heard the flames passing along before a brisk wind—the low crackling and rasping; the general effect of the two sounds is very much the same."

Persons in the East have often smiled incredulously at our statements that the locusts often impeded the trains on the western railroads. Yet such was by no means an infrequent occurrence in 1874 and 1875—the insects passing over the track or basking thereon, so numerously that the oil from their crushed bodies reduced the traction so as to actually stop the train, especially on an up-grade.

While the destruction of crops by the winged insects is often sudden and complete, the unfledged insects still more effectually, though more slowly, denude a country of vegetation, sometimes rendering the ground as bare and desolate in midsummer as it is in the Mississippi Valley in midwinter. The little creatures are often so thick, soon after hatching, that they blacken everything, and their hopping, as one passes through

* Wm. N. Byers, *Am. Entomologist*, I, p. 94.
† Wm. N. Byers, Hayden's Geol. Surv., 1870, p. 282.

a field or piece of prairie, gives the impression, at a short distance, as suggested by Mr. Whitman, of heat flickering in the air.

The migratory habit and great destructive power belong essentially to the Rocky Mountain locust.

As will appear from the two concluding chapters of this work, there are three or four very destructive and migratory species of locusts in Europe and Asia. There are also several other species which sometimes become very destructive, and still more rarely migrate from place to place in this country. Yet the Rocky Mountain locust is essentially the migratory and destructive species of North America, as none other compares with it in the vastness of its movements or the injury which it inflicts.

RATE AT WHICH LOCUST-SWARMS MOVE.

The rate of migration of the winged insects will depend entirely on circumstances. The history of the past four years shows conclusively that the rate of progress of invading swarms from the permanent breeding-places will average about 20 miles a day. It is, however, exceedingly irregular, and greatly dependent on the velocity of the wind. Bad weather may impede, or adverse winds divert flight.

"One noticeable feature of the invasions is the greater rapidity with which the insects spread in the earlier part of the season, while in fullest vigor, and the reduction in the average rate of progress the farther east and south they extend. The length of their stay depends much upon circumstances. Early in the summer, when they first begin to pour down on the more fertile country, they seldom remain more than two or three days; whereas, later in the season, they stay much longer. In speaking of the advent and departure of these insects, I use relative language only. The first comers, when—after having devoured everything palatable—they take wing away, almost always leave a scattering rear-guard behind, and are generally followed by new swarms; and a country once visited presents for weeks the spectacle of the insects gradually rising in the air between the hours of 9 or 10 a. m. and 3 p. m., and being carried away by the wind, while others are constantly dropping."

In short, the rate of spread is greatest during the first ten or fifteen days of their winged existence, or before the females become occupied with egg-laying. The invading insects are then passing the extensive plains and thinly-settled regions of the Northwest, where there is little inducement for them to halt, and the rate at such times, with strong and favorable wind, may reach a maximum of from two to three hundred miles a day.

The rate of spread of departing swarms from the temporary region is, as may be gathered from Chapter VII, very much the same. It is most rapid and direct early in the season when the insects first begin to leave more southern latitudes, and becomes more slack and inconstant as summer advances.

Extended flight does not take place till four or five days after the first insects become winged. For the first two or three days the newly-winged indiyiduals mingle with the larvæ and pupæ, eating ravenously and making short flights of a few yards or rods, as if to try their wings, recalling fully the habit of native, non-migratory species. Then for a while they rise one by one higher in the air and float along with the wind, and finally, when weather and wind are favorable, all that are strong and mature enough rise as with a common impulse during the warmer morning hours and move off vigorously in one direction till they are soon out

of sight. "They begin to rise when the dew has evaporated, and generally descend again toward evening. A swarm passing over a country yet infested with the mature insects, constantly receives accretions from these, and is, consequently, always more dense in the afternoon than in the forenoon. In rising, the insects generally face the wind; and it is doubtful if they could ascend to any great height without doing so."

The velocity of flight which, for many reasons, is quite distinct from the general movement understood by "rate of spread" or "migration," is naturally greater and will average about 10 miles an hour. It is also greatly dependent on the wind. Mr. S. S. Clevenger, of New Auburn, Minn., gives the average rate at 15 miles for that locality (App. 22); while the reports of other correspondents (App. 13) give the range from 4 to 40 miles, the more common rates mentioned being 12, 15, and 20 miles per hour. Mr. Brown Lusted, of Winnepeg, Manitoba, tells us that in 1867, when he was traveling from Saint Cloud, Minn., to Manitoba, the locusts were moving in the same direction, at from 30 to 35 miles a day. Professor Aughey's observations for 1877 (App. 8) give the rate per hour at 4 miles and upward; but he has himself expressed to us the belief that his estimates are somewhat low. We have ourselves never witnessed them flying so slowly as 4 miles per hour, which must be considered the minimum rate where there is no impediment. When tacking against the wind, they may move not more than one mile,* while the maximum rate, in a strong wind, may reach as high as 50 miles or more per hour.

DIRECTION OF INVADING SWARMS.

While there may be, during an invasion, local flights in all possible directions (except, perhaps, due west), the general movement east of the mountains is conspicuously toward the south and southeast. The more local and irregular flights are generally made for food, but the more extended southward movements are in obedience to other laws, discussed in Chapter XII of the Report, and also on p. 250. West of the main Rocky Mountain range the rule of flight appears to be from the higher plains and plateaus, where the insect normally breeds, to the lower and more fertile valleys; and the greater irregularity of the prevailing winds and more broken nature of the country preclude the same regularity in directions of flight that, on the whole, prevails east of the range.

TIME OF APPEARANCE OF INVADING SWARMS.

"In endeavoring to deduce general conclusions respecting the time of year that the 1874 swarms reached different parts of the country, great difficulty was experienced in sifting those accounts which referred to the progeny of the 1873 invasion, and those which hatched within the insect's native range, and came from the extreme Northwest. The same was true of the fresh 1876 swarms, and those which hatched in Minnesota."

As a rule, the insects which hatch in the temporary region acquire wings, and leave before the fresh swarms from the mountain region appear. In the more northern regions, as in Minnesota and Manitoba westward, the insects hatched on the ground acquire wings the latter part of June and in July. The period is earlier as we go south, until in Southern Texas they are able to fly in April. The time of appearance

*Mr. D. F. Weymouth, of Lyon, Marshall County, Minn., records their going west in 1865, in "the teeth of a strong wind, making scarcely a mile an hour." See also p. 160, *ante*.

of invading swarms from the permanent region is in inverse ratio, *i. e.*, earlier to the north and later to the south. Thus, while on the confines of the permanent region it is almost impossible to distinguish between the insects which hatch there and the fresh swarms from the Northwest, the difference becomes more and more marked toward the south and east.

"In 1874, swarms appeared during June in Southern Dakota; during July in Colorado, Nebraska, and Minnesota; during the latter part of this month in Iowa and Western Kansas. During August they came into Southeast Kansas and Missouri; and by the middle of October they reached Dallas, in Texas. In 1876 they came later."

FLIGHT AT NIGHT.

"It is the very general experience throughout the country subject to invasion that the winged insects rise as soon as the sun begins to dissipate the dew, and that they come down again toward evening as the sun's rays lose their power. It is a question, therefore, whether they ever continue flying during the night, and one which future investigation will doubtless settle. I am of the opinion that during the warmer midsummer and early fall season, when the insects are departing from their northwest hatching-grounds, they must not infrequently continue flight from necessity; for the descent of a swarm borne along in a strong current of air, at an altitude of over a mile above the earth, will depend more on some change in strength or direction of the current than on any other condition of the atmosphere."

The experience we have been able to gather during the year on this point is confirmatory of the views expressed in the above passage, and, in addition to the evidence brought forward (Commission Report, p. 147), we may cite the following facts:

Two years ago the locusts were seen to rise about sundown, three miles north of this place, and to alight in Oak Township, this county. In August, 1874, Messrs. H. Lamb and L. Conger were at work on the steeple of the Methodist Church, in this town. Looking toward the sky, they observed immense swarms of locusts going southwest for three consecutive days. They continued to pass up to 6 p. m., when the men left work, and none were heard of as alighting short of Mitchell and Smith Counties, in Kansas. The weather was dry, clear, and windy. The parties do not remember the exact days of the month, as they made no notes, but they are reliable, intelligent men.—(W. R. Follett, Malvern, Iowa, July 15, 1877.)

In one case, where the 'hoppers were very numerous, a person burnt a straw stack at night, and in the morning bushels of dead ones were found in and around it; perhaps they were drawn to it as the moth to a candle.—(W. J. Newell, Athol, Sioux County, Iowa, July 2, 1877.)

I never knew the insects to travel in sight during the night. They cannot, or will not, move in a heavy, damp atmosphere. But that they remain in the atmosphere during the night seems almost certain, probably at a great height. There must be a period from the time the winged insects take flight until the time they commence depositing eggs when they remain for days and nights very high in the atmosphere out of sight. This seems evident from the fact that when they first commence flying, and until they are all gone, they rise in immense swarms during the early part of the day, but seldom many come down again.—(E. Snyder, Atchison, Kans., June 26, 1877.)

Mr. G. G. Hay, of Saint Andrews, Manitoba, informed us, while staying with him, that in traveling, in 1868, to Saint Paul, he noticed on one occasion that as soon as the sun was up the air was filled with locusts, though those which had descended the previous day did not rise for several hours afterward on account of the heavy dew. Mr. N. V. McDowell, of Worthington, Minn. (App. 17), states it as his experience that they fly all night with favorable wind. We were also informed at the conference of governors, in 1876, by a reporter of the Omaha *Herald*,

whose name we have forgotten, that in order to test this question he had sent up a kite at night, covered on one side with tar, and that when it was brought down it was literally covered with locusts. The most convincing experience, however, is that of Professor Aughey's. In camping on the Bow River, in August, 1866, the wind, which was blowing from the northwest, suddenly changed to north soon after midnight, and locusts were heard pattering on his tent, and the insects were found thick the next morning where none had been seen the day before.

Singularly enough, we get no information from European writers on the question of flight at night.

That locusts are capable of long-sustained flight is evident from the well-authenticated instances of their being observed at sea hundreds of miles from land. One of the most striking instances is that recorded by Master E. G. Wiswell, of the Harrisburg. When this vessel, November 2, 1865, was in latitude 25° 28′ north, longitude 41° 33′ west, on her way from Bordeaux to New Orleans, the nearest land being about 1,200 miles, she was boarded during a heavy rain-storm by large numbers of locusts, that filled the air and covered the sails. The specimens were subsequently determined to be the European *Acridium perigrinum* by Mr. S. H. Scudder, who records the facts.

HEIGHT OF FLIGHT.

This subject has already been considered in Chapter VII (p. 144). There is no doubt whatever that the insects often move over a country entirely above the reach of human vision. In ordinary flights we observe only the lower individuals, and in looking toward the sun we may always observe others, farther and farther away, until the glittering specks are lost to sight. In cloudy weather they are not noticeable, unless very dense, so as to darken the atmosphere, until within about 1,000 feet; yet it is well known that they fly at times nearly, if not full, two miles above ground, as they have been seen flying toward the plains as high above the highest peaks of the Rocky Mountains as a good telescope would resolve them.

GENERAL HABITS AT NIGHT.

Regarding the general habits of the species at night, a glance at the experience obtained in answer to our circulars (App. 17) is sufficient to show that it differs widely and is often contradictory. This is not surprising, as so much in the habits and ways of our locust depends on conditions of the weather, season, &c. We have had an extensive experience both with the unfledged and full-fledged insects, and the result of it is that, as a rule, the young insects are quiet at night, either hiding under some shelter upon the ground or roosting away from the ground. The former is more apt to be the case in cold, the latter in wet weather. In cool weather even the mature insects do not feed at night, but when the weather is warm and dry these are often as ravenous during the night as during the day. Gerstäcker remarks of the European *migratoria* that it feeds most at night.

As the insects advance in age the roosting habit becomes greater, and for a few days after getting wings the mature insects delight to gather away from the ground, especially on trees. * * *

WHERE THE EGGS ARE LAID.

"The eggs may be laid in almost any kind of soil, but by preference they are laid in bare, sandy places, especially on high, dry ground, which

is tolerably compact and not loose. It is often stated that they are not laid in meadows and pastures, and that hard-road-tracks are preferred; in truth, however, meadows and pastures, where the grass is closely grazed, are much used for ovipositing by the female, while on well-traveled roads she seldom gets time to fulfill the act without being disturbed. Thus a well-traveled road may present the appearance of being perfectly honey-combed with holes, when an examination will show that most of them are unfinished and contain no eggs; whereas a field covered with grass-stubble may show no signs of such holes and yet abound with eggs." In fact, wherever holes are noticed, it may generally be taken for granted that they contain no eggs, for the mother covers well the hole when she has time to properly complete her task.

"Furthermore, the insects are more readily noticed at their work along roads and road-sides than in fields; a fact which has also had something to do in forming the popular impression. Newly-plowed land is not liked; it presents too loose a surface; but newly-broken sward is often filled with eggs. Moist or wet ground is generally avoided for the purpose under consideration."

We have noticed that in the Permanent breeding-region, wherever the vegetation is scant, the females show a decided preference for the shaded base of shrubby plants, among the roots of which they like to place their eggs; whereas in the Temporary region, where the vegetation is generally so much ranker, exposed situations, or those comparatively bare of vegetation, are preferred. The experience of 1876 proved very conclusively, also, that they are instinctively guided toward cultivated fields, where the young will find good pasturage; for the eggs were noticeably thickest and hatched most numerously in 1877 in cultivated areas. In the Cypress Hills region of British America, as Mr. J. G. Kittson informs us, the high lands and protected slopes of the hills are preferred. The soil of the mountain region, where the insects permanently breed, is mostly of a compact, scantily covered, gravelly nature, and the notion that they lay most in pure sand is an erroneous one.

Sandy soil that is compact, especially when having a south or east exposure, is much chosen, but in loose and shifting sand the eggs would perish. In 1876, it was generally remarked that the insects were more indifferent than usual in ovipositing, and that eggs were much more frequently laid in low, and even wet, land than in former years.

The mass seldom reaches more than an inch below the surface, except where some vegetable root has been followed down and devoured, and the insect leaves her eggs before emerging; in this way the mass is sometimes placed a foot below the surface. In abnormal or unhealthy conditions, the eggs may be laid in exposed places without any hole, in which case they doubtless never give birth to young. In other cases, the female will fill her hole almost entirely with the sebific matter. Nor are the eggs invariably laid in the ground, for while we know of no exceptions to this normal position in *spretus*, yet Mr. Boll informs us that around Dallas, Tex., in 1876, the eggs of *differentialis* were very numerously placed under the bark of elm and hackberry logs that had been felled on low land. We have also received from A. W. Hoffmeister, of Fort Madison, Iowa, the eggs of a species of *Stenobothrus*, and the young that hatched from them, the eggs having been thrust into holes made by some carpenter-bee in a fence-post; while *Chlöealtis conspersa* habitually bores in dead wood.

MANNER IN WHICH THE EGGS ARE LAID.

"The female, when about to lay her eggs, forces a hole in the ground by means of the two pairs of horny valves which open and shut at the

tip of her abdomen, and which, from their peculiar structure, are admirably fitted for the purpose. (See Pl. I, Fig. 2, where *b*, *c*, show the structure of one of each of the upper and lower valves.) With the valves closed she pushes the tips into the ground, and by a series of muscular efforts and the continued opening and shutting of the valves she drills a hole, until in a few minutes (the time varying with the nature of the soil) nearly the whole abdomen is buried. The abdomen stretches to its utmost for this purpose, especially at the middle, and the hole is generally a little curved, and always more or less oblique (Pl. I, Fig. 1, *d*). Now, with hind legs hoisted straight above the back, and the shanks hugging more or less closely the thighs, she commences ovipositing."

When the hole is once drilled there exudes from the tip of the body a frothy, mucous matter, which fills up the bottom of the hole, and bathes the horny valves. This is the sebific fluid which is secreted by the sebific or cement gland described with the other anatomical details given in Chapter IX. By repeatedly extricating and studying specimens in every possible stage of oviposition, we have been able to ascertain the exact method by which the egg-mass is formed. The process has never been accurately described by other writers, and the general impression—upon which figures like those of Gerstäcker's* are founded—is that the eggs are extruded from between the distended hooks or valves. If we could manage to watch a female from the time the bottom of her hole is moistened by the sebific fluid, we should see the valves all brought together, when an egg would pass down the oviduct (Pl. I, Fig. 3, *j*) along the ventral side, and, guided by a little finger-like style (the *gubernaculum ovi*, *g*), "pass in between the horny valves (which are admirably constructed, not only for drilling but for holding and conducting the egg to its appropriate place), and issue at their tips amid the mucous fluid already spoken of. Then follows a period of convulsions, during which more mucous material is elaborated, until the whole end of the body is bathed in it, when another egg passes down and is placed in position. These alternate processes continue until the full complement of eggs are in place, the number ranging from 20 to 35, but averaging about 28. The mucous matter binds all the eggs in a mass, and when the last is laid the mother devotes some time to filling up the somewhat narrower neck of the burrow with a compact and cellulose mass of the same material, which, though light and easily penetrated, is more or less impervious to water, and forms a very excellent protection (Pl. I, Fig. 5, *d*)." When fresh the mass is soft and moist, but it soon acquires a firm consistency.

"During the operation the female is very intent on her work, and may be gently approached without becoming alarmed, though when suddenly disturbed she makes great efforts to get away, and extricates her abdomen in the course of a few seconds, the time depending on the depth reached."

The legs are almost always hoisted straight above the back during the process, as shown in the figure (Fig. 1), with the shanks hugging more or less closely the thighs. Sometimes, however, especially when the abdomen is fully buried, the ends of the hind feet may rest firmly on the ground, as has been observed by Mr. Packard in the case of *femur-rubrum*.

"The time required for drilling the hole and completing the pod will vary according to the season and the temperature. During the latter part of October or early in November, 1876, when there was frost at night and the insects did not rouse from their chilled inactivity until 9

* Die Wanderheuschrecke, Berlin, 1876, Taf. II, Fig. 4.

o'clock a. m., the females scarce had time to complete the process during the four or five warmer hours of the day; but with higher temperature not more than from two to three hours would be required."

We have been for weeks with the insects where they were so thickly ovipositing that the light, clay-yellow ground would be darkened by them, and have laid on a closely-grazed sward for hours with specimens in the act all around, and have repeatedly verified all that we have here described.

PHILOSOPHY OF THE EGG-MASS.

"To the casual observer, the eggs of our locust appear to be thrust indiscriminately into the hole made for their reception. A more careful study of the egg-mass, or egg-pod, will show, however, that the female took great pains to arrange them, not only so as to economize as much space as possible, consistent with the form of each egg, but so as to best facilitate the escape of the young locust; for if, from whatever cause, the upper eggs should fail to hatch, or should hatch later than the lower ones, the former would offer an impediment to the exit of the young in their endeavors to escape from these last, were there no provision against such a possibility. The eggs are, indeed, most carefully placed side by side in four rows, each row generally containing seven. They oblique a little crosswise of the cylinder (Pl. I, Fig. 4, *a*). The posterior or narrow end, which issues first from the oviduct, is thickened, and generally shows two pale rings around the darker tip (Pl. I, Fig. 5, *b*). This is pushed close against the bottom of the burrow, which, being cylindrical, does not permit the outer or two side rows to be pushed quite so far down as the two inner rows, and for the very same reason the upper or head ends of the outer rows are necessarily bent to the same extent over the inner rows, the eggs when laid being somewhat soft and plastic. There is, consequently, an irregular channel along the top of the mass (Pl. I, Fig. 5, *c*), which is filled only with the same frothy matter that surrounds each egg, which matter occupies all the other space in the burrow not occupied by the eggs. The whole plan is seen at once by a reference to the figure referred to, which represents, enlarged, a side view of the mass within the burrow (*a*), and a bottom (*b*) and top (*c*) view of the same, with the earth which adheres to it removed."

This same quadrilinear arrangement of the eggs occurs, also, in the egg-mass of the Red-legged and Lesser locusts, and in most of the species of medium size which we have studied, including several different genera. Yet it is by no means constant in the same genus, since, as we shall see in Chapter XI, the egg of *Caloptenus differentialis* are irregularly arranged. This irregular arrangement also occurs in the eggs of *Œdipoda phanœcoptera* and *Acridium Americanum*, and in these species the cement which binds the eggs together is more copious than in the others.* In one narrow-bodied species (*Eucoptolophus sordidus*) the eggs are arranged in but three rows.

Even in the pods of those species which have the eggs irregularly arranged the head-ends point either mostly outward (*differentialis*) or inward (*Americanum*), so that the young locusts may either push out at the sides or through a central space.

The length of the neck, or that portion containing no eggs, varies not only in different species but in different masses of the same species.

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*The species occurring around Saint Louis in the eggs of which we have noticed the same quadrilinear arrangement as in those of *spretus*, are, aside from those already mentioned *Caloptenus bivittatus*, *Pezotettix viola*, *P. unicolor*, *Chrysocraon viridis*, *Tragocephala viridifasciata*, *Œdipoda carolina*, *Œ. sulfurea*, and *Eucoptolophus costalis*.

DOES THE FEMALE LAY MORE THAN ONE EGG-MASS?

This is a question often asked, but which the average farmer has no means of definitely answering. "It is the rule with insects, particularly with the large number of injurious species belonging to the Lepidoptera, that the eggs in the ovaries develop almost simultaneously, and that when oviposition once commences it is continued uninterruptedly until the supply of eggs is exhausted. Yet there are many notable exceptions to the rule among injurious species, as in the cases of the common Plum-curculio and the Colorado potato-beetle, which oviposit at stated or irregular intervals during several weeks, or even months. The Rocky Mountain locust belongs to this last category, and the most casual examination of the ovaries in a female, taken in the act of oviposting, will show that, besides the batch of fully-formed eggs then and there being laid, there are other sets, diminishing in size, which are to be laid at future periods. This, I repeat, can be determined by any one who will take the trouble to carefully examine a few females when laying. But just how often or how many eggs each one lays is more difficult to determine. With *spretus* I have been able to make comparatively few experiments; but on three different occasions I obtained two pods from single females, laid at intervals of eighteen, twenty-one, and twenty-six days, respectively. I have, however, made extended experiments with its close congeners, *femur-rubrum* and *atlanis*, and in two cases, with the former, have obtained four different pods from one female, the laying covering periods of fifty-eight and sixty-two days, and the total number of eggs laid being 96 in the one case and 110 in the other. A number of both species laid three times, but most of them—owing, perhaps, to their being confined—laid but twice."

Yersin concludes, referring to the European *migratoria*, that eggs are laid thrice, at intervals of about a month, while Krünitz, Keferstein, and Stoikowitsch* also declare that they are laid in three different masses. Professor Whitman, in his 1876 experiments, had a female which laid about the middle of July, and died September 9, without laying again, though eggs were found in the ovaries at death. The time between the first and second laying, observed by Körte, was six days. Mr. Aughey, from experiments made in 1876, found the interval still shorter, ranging from two to three days; but he requests us to add that other experiments, not recorded, showed a much longer interval between the periods, extending in some cases to twenty days. It would thus appear that there is the greatest diversity in the time intervening between the periods of egg-laying, and that the number of egg-masses formed by one individual is by no means constant. It is natural to suppose that there will be great difference in individual prolificacy, and we are also of the opinion that there is great difference in this respect in different generations—those that hatch in the permanent region being more prolific than those which hatch in the temporary region. This opinion is not only warranted by the general experience of farmers, but also by experiment. As compared with those of 1876, the autumn flights of 1877 were for the most part intestate, and it was very generally noticed that they laid no eggs. There is, as we have seen in the preceding chapter, the best of reasons for believing that these flights were not from the permanent region, but consisted mainly of insects that had bred in the temporary region.

It is well known that the reproductive organs are easily affected by

* See Koppen, p. 36.

any sudden change of climatic conditions which animals may be subjected to, and that sterility is one of the most frequent consequences of such change. It was upon this general rule that the late B. D. Walsh, knowing nothing of the return migration, based the theory that the Rocky Mountain locust could never thrive in the temporary region, but would become intestate and perish there. In 1876 we had measurable success in getting *spretus* to lay eggs in confinement. In 1877, though we made far more strenuous efforts with the insects that hatched in Texas and Kansas, yet we signally failed. Of many thousands which we hatched in Saint Louis and endeavored to rear under the most favorable circumstances in vivaria containing growing grain, most of them died in from three to eight days from hatching. We succeeded in bringing a few through the third and two through the fourth molt. At Carbondale, Ill., from Minnesota eggs, Mr. Thomas had better luck, and reared several to the winged condition. We repeatedly dispatched living specimens both of the pupæ and the mature insects from Texas, Kansas, and Iowa, to our office-clerk, Mr. Th. Pergande, Saint Louis, but with no more favorable results, as he entirely failed to obtain eggs, and the females, when dead, were found, upon examination, to contain none. This want of fecundity, though not universal, was quite general with the insects of 1877, and is in keeping with the general experience as to the sickly and degenerate nature of the brood.

It is quite manifest, therefore, that in answering the question we have just asked we can do so only in a general and qualified manner. The number of eggs produced by a well-developed locust will range from 100 to 150, if we consider species generally. We have counted 171 in one mass of *Caloptenus differentialis;* from 120 to 130 in those of *Œdipoda phanœcoptera*, and about 120 in that of *Acridium Americanum.* The great probability is that the eggs of such species are all laid at once. In species like *spretus*, which rarely lay more than 30 eggs in one mass, it were natural to infer that different layings take place, even did the facts at hand not prove such to be the case. In 1876 the insects were pushing continuously southward from the middle of August till the end of October, and during most of this time they were laying eggs. In fact, throughout the country invaded, from Minnesota to South Texas, they continued laying till frost, and we know from examinations that many of them perished before all the ova had been disposed of. Stragglers were even noticed in Texas as late as December.

To sum up the inquiry, we would give it as our belief that the laying season normally extends from six to eight weeks; that it may be shortened or lengthened by conditions of weather and climate; that fecundity is materially affected by the same conditions; that the average number of egg-masses formed is three; and that the average interval between the periods of laying by the same female is two weeks.

THE HATCHING PROCESS.

"Carefully examined, the egg-shell is found to consist of two layers. The outer layer, which is thin, semi-opaque, and gives the pale, cream yellow color, is seen by aid of a high magnifying power to be densely, minutely, and shallowly pitted; or, to use still more exact language, the whole surface is netted with minute and more or less irregular, hexagonal ridges (Pl. I, Fig. 4, *a*, *b*). It is a mere covering of excreted matter, similar in nature to the mucous or sebific fluid already described, which binds the eggs together. The inner layer (or *chorion*) is thicker, of a deeper yellow, and perfectly smooth. It is also translucent, so that, as the hatching period

approaches, the form and members of the embryon may be distinctly discerned through it. The outer covering is easily ruptured, and is rendered all the more fragile by freezing; but the inner covering is so tough that a very strong pressure between one's thumb and finger is required to burst it. How, then, will the embryon, which fills it so compactly that there is scarcely room for motion, succeed in escaping from such a prison? The rigid shell of the bird's egg is easily cracked by the beak of its tenant; the hatching caterpillar, curled within its egg-shell, has room enough to move its jaws and eat its way out; the egg-coverings of many insects are so delicate and frail that the mere swelling of the embryon affords means of escape; those of others are so constructed that a door flies open, or a lid lifts by a spring, whenever pressure is brought to bear; in some two halves open, as in the shell of a muscle; whilst in a host of others the embryon is furnished with a special structure called the egg-burster, the office of which is to cut or rupture the shell, and thus afford means of escape. But our young locust is deprived of all such contrivances, and must have another mode of exit from its tough and subelastic prison. Nature accomplishes the same end in many different ways. She is rich in contrivances. The same warmth and moisture which promote the development of the living embryon also weaken the inanimate shell, by a process analogous to decomposition, and by a general expansion consequent upon the swelling of the embryon within. Thus, the eggs when about to hatch are much more plump and somewhat larger and more transparent than they were when laid. At last, by the muscular efforts of the nascent locust, and the swelling of its several parts, especially about the head and mouth, the shell gives way, generally splitting along the anterior ventral part. The whole process may, in fact, be likened to the germination of a hard-covered seed, when planted in moist ground, and, precisely as in this latter case, there is in some loose soils a certain heaving of the ground from the united swelling of the locust eggs. All the eggs in a given mass burst very nearly at one and the same time, and in that event the lowermost individuals await the escape of those in front of them, which first push their way out through the neck of the burrow (Fig. 4, *d*) provided by the parent.

"They all escape, one after the other, through one small hole, which in the field is scarcely noticeable. Such is the usual mode of hatching; but when the young from the lower eggs hatch first, or when the upper eggs perish and leave the lower ones sound—as is not unfrequently the case—the exit is nevertheless easily made along the channel already described (Pl. I, Fig. 5, *c*)."

When once the shell is ruptured the nascent larva soon succeeds, by a series of undulating movements, in working free therefrom and making its way to the light in the manner just described. Once on the surface of the ground it rests for a few minutes, generally lying on the side. Its members are still limp and directed backward, and it is yet enveloped in a very delicate film or pellicle, which must be cast off before the little creature can move with alacrity.

By continuance of similar contracting and expanding movements which freed the animal from the earth, this film in a very short time splits along the middle of the back near the head (strictly the prothorax), and is then worked off behind, and finally kicked from the hind feet in a little white crumpled pellet, that has justly been likened by some of our correspondents to a diminutive mushroom. These little pellets invariably lie close around the hole in the ground from which the young locusts issued. The pellicle begins to split, under ordinary conditions

of warmth, within a minute from the time the locust is fairly out of the ground, and is shed in from one to five minutes, according to circumstances. Pale and colorless when first freed from this pellicle, the full-born locust is nevertheless at once capable of considerable activity, and in the course of an hour assumes its natural dark gray coloring. Mr. Packard observed (Report to Dr. Hayden, 1877, p. 634) that specimens which hatched at 11 a. m. began to turn dark at 3 p. m., thus showing that the time may vary; but numerous close observations which we have made on single individuals show that an hour seldom passes after the amnion is thrown off before the gray color is acquired.

"From this account of the hatching process, we can readily understand why the female in ovipositing prefers compact or hard soil to that which is loose. The harder and less yielding the walls of the burrow, the easier will the young locust crowd its way out.

"Though the covering which envelops the little animal when first it issues from the egg is quite delicate, it nevertheless, in the struggles of birth, undoubtedly affords much protection, and it is an interesting fact that while, as we have just seen, it is shed within a few minutes of the time when the animal reaches the free air, it is seldom shed if, from one cause or other, there is failure to escape from the soil, even though the young locust may be struggling for days to effect an escape.

"While yet enveloped in this pellicle, the animal possesses great forcing and pushing power, and if the soil be not too compact, will frequently force a direct passage through the same to the surface, as indicated at the dotted lines, Pl. I, Fig. 5, *e*. But if the soil is at all compressed it can make little or no headway, except through the appropriate channel (*d*). While crowding its way out the antennæ and four front legs are held in much the same position as within the egg, the hind legs being generally stretched. But the members bend in every conceivable way, and where several are endeavoring to work through any particular passage, the amount of squeezing and crowding they will endure is something remarkable. Yet if by chance the protecting pellicle is worked off before issuing from the ground, the animal loses all power of further forcing its way out. The instinctive tendency to push upward is also remarkable. In glass tubes, in which I have had the eggs hatching in order to watch the young, these last would always turn their heads and push toward the bottom whenever the tubes were turned mouth downward; while in tin boxes, where the eggs were placed at different depths in the ground, the young never descended, even when they were unable to ascend on account of the compactness of the soil above."

WHERE AND UNDER WHAT CONDITIONS OF SOIL THE YOUNG HATCH MOST FREELY.

As may be gathered from a series of experiments recorded in Chapter XIII, the eggs will hatch under the most varied conditions. As a rule, the soils and locations preferred by the female in ovipositing will be those in which the young will most freely hatch, viz., compact and sandy or gravelly knolls and hillsides with a south or southeast exposure.

The experience of 1877 shows also that hatching takes place very freely in late-mown meadows or prairies or grazed pastures, where the exposure of the ground permits ready oviposition and the warmth of the sun. In dry, well-drained, and compact soils of a light nature the eggs are much better preserved than in heavy clays and loams, where they are more subject to mold and rot. The experience of 1877 is rather misleading on this point, and indicates the necessity of generalizing, not from the expe-

rience of one, but of many years. The insects were most numerous, and seemed to hatch most numerously in the low lands and in sheltered situations along river-courses. The facts are that in such situations those which did hatch survived in larger proportions than did those which hatched in more exposed places, because the former were better protected from the cold rains and storms of spring.

TIME OF HATCHING.

Here, again, we cannot take the experience of any one year as a guide, but find the necessity of generalizing from all past experience. In much of the locust area there prevailed such late warm weather in the autumn of 1876 that considerable numbers of the young hatched prematurely; and such is very generally the case. We had also some unseasonably warm weather in January and February, 1877, during which large numbers hatched. These all subsequently perished. During the latter part of March and early in April the hatching was general, but there followed a period of cold, rainy weather, which checked the hatching and destroyed a large number of the insects that had hatched. May and June were characterized by abundant rains and storms, alternating with warm, sunny weather, causing the hatching to be irregular and in some cases quite retarded. It would not be incorrect, therefore, to say that in one and the same neighborhood the hatching commenced on the 1st of February, and did not cease till the end of June, thus covering a period of five months. Yet this is exceptional, and it has been much more regular and the period more restricted in previous years.

Those eggs which are laid earliest the previous year will also hatch earliest; and since the egg-laying covers an average period of six or eight weeks in the same locality and lasts generally till frost, it follows that the eggs pass the winter in every state of development—some with the fluids clear and limpid, others with the embryo fully formed and ready at at the first approach of spring to hatch. This we found also to be actually the case, for many hundreds of egg-masses examined during the winter of 1876–'77, from divers parts of the infested region, showed every state of development.

In the same locality hatching will take place—*cæteris paribus*—first on light dry soils and on south and southeast exposures; latest on low, moist, and shaded or tenacious ground.

We see, therefore, that the hatching will not alone vary according to temperature and the earliness or lateness of the spring, but that it is quite variable under the same conditions. In every instance there will be a few hatching when the first hatched in the same locality are getting wings; and we give it as a general rule that the bulk of the eggs hatch out in the different latitudes about as follows:

In Texas, from the middle to the last of March.

In the southern portions of Missouri and Kansas, about the second week in April.

In the northern parts of Missouri and Kansas and the southern sections of Iowa and Nebraska, the latter part of April and first of May.

In Minnesota and Dakota the usual time for hatching ranges from early in May in the southern portions to the third week in the northern extremity.

In Montana and Manitoba, from the middle of May to the first of June.

In short, the bulk of the insects hatch in ordinary seasons about the middle of March in latitude 35°, and continue to hatch most numerously

about four days later with each degree of latitude north, until along the forty-ninth parallel the same scenes are repeated that occurred in Southern Texas seven or eight weeks before.

From a number of experiments which we have made on the eggs, we conclude that, with a constant temperature of 85° F., with favorable conditions of soil, the eggs will hatch in from four to five weeks after they are laid, and in a temperature of 75° F. in about six weeks. Mr. Riley has had the eggs of *Caloptenus atlanis* (laid in July) hatched in from three to four weeks; those of *Tragocephala viridifasciata* (laid in June) in three weeks; and those of *Acridium Americanum* (laid in July) in rather more than a month.

HABITS OF THE YOUNG OR UNFLEDGED LOCUSTS IN THE TEMPORARY REGION.

"The habits of the young insects as they occur in the temporary region, and particularly in the country south of the forty-fourth parallel and east of the one hundredth meridian, are as follows: Although possessed of remarkably active powers from the moment they leave the egg, yet so long as provision suffices for them on their hatching-grounds the young remain almost stationary and create but little apprehension. As soon, however, as the supply of food in these situations is exhausted, they commence to migrate, frequently in a body a mile wide, devouring, as they advance, all the grass, grain, and garden-truck in their path. 'The migrating propensity is not developed until after the first molt, and often not till after the second or third. Up to that time they are content to huddle in warm places, and live for the most part on weeds, and especially on the common Dog-fennel or May-weed (*Maruta*), where it is present.

"The young locusts display gregarious instincts from the start, and congregate in immense numbers in warm and sunny places. They thus often blacken the sides of houses or the sides of hills. They remain thus huddled together during cold, damp weather. When not traveling, and when food is abundant, or during bad, rainy weather, they are fond of congregating on fences, buildings, trees, or anything removed from the moist ground. They also prefer to get into such positions to undergo their different molts. In fields they collect at night or during cold, damp weather, under any rubbish that may be at hand, and may be enticed under straw, hay, &c., scattered on the ground. Old prairie-grass affords good shelter, and where a wheat-field is surrounded with unburned prairie, they will gather for shelter along the borders of this last."

It is more particularly while they are yet small, or in the first, second, and third stages, that the young locusts hide at night, and, during unfavorable weather, at day also. In windy weather they are fond of gathering and secreting under any shelter, or in crevices and inequalities of the soil. At such times farmers too often conclude that the pests have perished and vanished; but a few hours of pleasant, sunny weather will bring the insects to sight again and dispel the delusion. When very vigorous and numerous they gradually move across a field of small grain and cut it off clean to the ground as they go, appearing to constantly feed. But when diseased or sickly, as in 1877, they gather in bare and sunny spots and huddle and bask without feeding. The very cold, wet weather that is prejudicial to them is beneficial to the grain, and under such circumstances it generally grows so rank and rapidly that they make little impression upon it.

It is when they are abundant and vigorous enough to bare the ground

of vegetation, and this principally after they are half-grown, that the habit of migrating in large bodies is developed. In 1877 scarcely any disposition to migrate was shown, and this was in strong contrast with what occurred in 1875. In a year like this last, when they are vigorous and abundant, their power for injury increases with their growth. "At first devouring the vegetation in particular fields and patches in the vicinity of their birthplaces, they gradually widen the area of their devastation, until at last, if very numerous, they devour every green thing over extensive districts. Whenever they have thus devastated a country they are forced to feed upon one another, and perish in immense numbers from debility and starvation. Whenever timber is accessible they collect in it, and after cleaning out the underbrush, feed upon the dead leaves and bark. A few succeed in climbing up into the rougher-barked trees, where they feed upon the foliage, and it is amusing to see with what avidity the famished individuals below scramble for any fallen leaf that the more fortunate mounted ones may chance to sever. This increase in destructiveness continues until the bulk of the locusts have undergone their larval molts and attained the pupa state. The pupa, being brighter colored, with more orange than the larva, the insects now look, as they congregate, like swarms of bees. From this time on they begin to decrease in numbers, though retaining their ravenous propensities. They die rapidly from disease and from the attacks of natural enemies, while a large number fall a prey, while in the helpless condition of molting, to the cannibalistic proclivities of their own kind. Those that acquire wings rise in the air during the warmer parts of the day, and wend their way as far as the wind will permit toward their native home in the Northwest. They mostly carry with them the germs of disease or are parasitized, and wherever they settle do comparatively little damage."

DIRECTIONS IN WHICH THE YOUNG LOCUSTS TRAVEL.

The young insects when migrating move, as a rule, during the warmer hours of the day only, feeding, if hungry, by the way, but generally marching in a given direction until toward evening. They travel in schools or armies, to no particular or constant point of the compass, but purely in search of food—the same school one day often pursuing a different course from that pursued the day previous. On this point the experience of 1875 as well as of 1877 is conclusive, though the bulk of the testimony as to their actions, when hatching out in the more northern States, is to the effect that the prevailing direction taken is south or southeast, while in Southern Texas it is just opposite, or north. A person traveling along a road may often see one army marching in one direction to the left and another in the opposite direction to the right, and we have repeatedly had such an experience.

If, from any reason whatsoever, the vanguard of a column changes its course, the changed direction is in some way communicated in wave-like form to those in the rear. Usually, the front of a column is not easily diverted, however, but will pass through such obstacles as open fences rather than change course. Sometimes two schools going in different directions will cross each other, the individuals of either keeping to their particular course and presenting a singular spectacle as they hop past one another.

It is recorded in Europe that few things, not even water, stop the armies of the young locusts when on the march, and Döngingk relates having seen them swim over the Dnjestr for a stretch of $1\frac{1}{4}$ German miles, and in layers 7 or 8 inches thick.* We have had similar experi-

* Köppen *loc. cit.*, p. 43.

ence with our own species. In 1875, near Lane, Kans., they crossed the Pottowatomie Creek, which is about four rods wide, by millions; while the Big and Little Blues, tributaries of the Missouri, near Independence, the one about 100 feet wide at its mouth, and the other not so wide, were crossed at numerous places by the moving armies, which would march down to the water's edge and commence jumping in, one upon another, till they would pontoon the stream, so as to effect a crossing. Two of these mighty armies also met, one moving east and the other west, on the river-bluff, in the same locality, and each turning their course north and down the bluff, and coming to a perpendicular ledge of rock 25 or 30 feet high, passed over in a sheet apparently 6 or 7 inches thick, and causing a roaring noise similar to a cataract of water. (Riley's Eighth Report, p. 118.)

The experience of correspondents as to the movements of the young is very conflicting, as it naturally would be from what we have already said. One man will notice the insects moving with the wind, and conclude that it is the rule for them to do so; another, against the wind, and draw an opposite conclusion.

RATE AT WHICH THE YOUNG TRAVEL.

"When about half-grown they seldom move at a greater rate than three yards a minute, even when at their greatest speed over a tolerably smooth and level road, and not halting to feed. They walk three-fourths this distance and hop the rest. Two consecutive hops are seldom taken, and any individual one may be run down and fatigued by obliging it to hop ten or twelve times without a rest."

According to Sydow, the young of the European *migratoria* travel, when at their most rapid gait, a German mile in four hours. Even taking the shortest German mile, or nearly four English miles, we very much doubt the accuracy of this statement, for though the *migratoria* is a larger species than *spretus*, we cannot believe that it travels nearly ten times as fast, and we have again and again timed our own species.

THEY REACH, IN THE TEMPORARY REGION, BUT A FEW MILES EAST OF WHERE THEY HATCH.

"At the rate at which they travel, as just described, they could not extend many miles, even if they continued to travel in one direction from the time of hatching until maturity. They travel, on an average, not more than 6 hours per day; and their unfledged existence terminates in from 6 to 8, say 7 weeks. It is very easy to calculate from these facts that if they continued in one direction from the time they hatch until they acquire wings, they could not extend 30 miles. In reality, however, they do not travel every day; and where food is abundant they scarcely travel at all."

Moreover, as we have just shown, the migratory propensity is seldom manifested during the first or second larval stages, and it is, in fact, largely dependent on conditions of health and vigor of the insects and on the amount of food supply. We have learned of no cases where the young have extended, during growth, ten miles east of the hatching limit.

As experience abundantly proves, the insects, when they get wings in the Temporary region, especially in early summer, instinctively fly to the north or northwest, and do not extend to do damage farther east. Those, also, which acquire wings later in the summer in more northerly regions,

and which fly more to the south, never extend any great distance east of where they hatch; those developing on the eastern confines of the species' range (see map) passing southwestwardly, and those born toward the mountains southeastwardly. In 1875, a few stragglers were carried as far as the center of Missouri, by being swept into the Missouri River, and drifting on logs and chips during the annual rise in July. But whenever scattering individuals are carried in this or any other way beyond the eastern limits we have laid down, they soon perish. Most of them are diseased or disabled, and if they lay eggs, these hatch in the autumn and perish at the approach of winter.

REMEDIES AND DEVICES FOR DESTRUCTION.

In this chapter we shall treat of the available means to be employed either for the destruction of the Rocky Mountain locust in one state or another or for preventing its injuries. The instructions of the former character will apply more especially to what we have termed the Temporary region, or that more fertile country subject to occasional visitation, but in which the insect is not indigenous; the suggestions of the latter, to what we have called the Permanent region.

During the summer of 1877, we received a number of plans and suggestions for the destruction of the locust; some of them direct, others through the Department of the Interior. Many of these were sent by persons having no experience whatever with the insect, and were purely theoretical or visionary; while others were intended to gratuitously advertise some pet patent nostrum. We have taken notice of those only which gave some promise of possible usefulness. Of the machines and devices for destruction submitted to us, we have endeavored, as far as time would permit, to personally examine and test in the field all such as appeared worthy of trial; and, where personal attention could not be given, to have such test made by competent parties. We shall illustrate or describe all which came under our notice that are in any way worthy of consideration.

The means to be employed for the destruction of this pest very naturally fall into five divisions: 1. Encouragement of natural agencies. 2. Destruction of the eggs. 3. Destruction of the young or unfledged insects. 4. Destruction of the mature or winged insects. 5. Preventive measures.

ENCOURAGEMENT OF NATURAL AGENCIES.

While little practically can be done by man to further the multiplication of the more minute enemies of the locust, much may be done to protect and to promote the multiplication of the larger animals, especially the birds. These should be protected by most stringent laws, firmly carried out, restraining the wanton destruction too often indulged in by sportsmen and others. Some of the States interested in this question have of late years passed good laws for the protection of these feathered friends, but the laws are, unfortunately, too often a dead letter for want of enforcement. One of the most effectual and successful ways of protecting and encouraging many of the smaller birds is to offer a reward for hawks. This has been done with very beneficial results in Colorado, and other States would do well to follow her example.

DESTRUCTION OF THE EGGS.

The destruction of the eggs has been followed, in the older countries of the East, since Pliny's time, and has long been recognized in Europe and Asia as one of the most efficacious means of averting locust injury. These eggs are laid in masses, just beneath the surface of the ground, seldom to a depth of more than an inch; and we have already considered the character of soil and the sites preferred by the females in laying them. In years like 1874 and 1876 we have known favorable locations, for many hundreds of square miles, so thickly supplied with these eggs, that scarcely an inch of the soil could be stirred without exposing them. As a rule, the dead bodies of the locusts strewn about the ground in autumn are a good indication of the presence of eggs in such ground, though the eggs may often be abundant without this indication. The means to be employed in destroying locust-eggs may be considered under the following divisions: 1. Harrowing; 2. Plowing or spading; 3. Irrigation; 4. Tramping; 5. Collecting.

"There are many questions respecting the manner in which the eggs of this locust are affected under different conditions, which are of intense practical interest, and which are frequently discussed with no definite result being arrived at, and no positive conclusion drawn. Such are, for instance, the influence of temperature, moisture, and dryness upon them; the effects of exposing them to the air; of breaking open the pods; of harrowing or plowing them under at different depths; of tramping upon them. Everything, in short, that may tend to destroy them or prevent the young locusts hatching is of vital importance."

With a view of settling some of these questions, and in the hope of reaching conclusions that might prove valuable, Mr. Riley carried on, at Saint Louis, during the winter of 1876–'77, a series of experiments, some of which we shall report, in their proper connection, as they were originally recorded.

By reference to the following meteorological table, the exact temperature at any of the dates mentioned may be ascertained:

Temperature at Saint Louis, Mo., of winter of 1876–'77.

1876.	Max.	Min.	Mean.	1876.	Max.	Min.	Mean.
November 15	41	30	37	December 13	50	38	42
16	44	35	39	14	38	18	27
17	47	40	44	15	45	12	36
18	47	25	34	16	44	4	12
19	36	22	32	17	27	13	20
20	45	31	38	18	22	2	16
21	47	32	37	19	37	18	28
22	42	23	35	20	43	23	33
23	45	31	36	21	43	23	34
24	51	32	41	22	37	20	26
25	47	31	40	23	24	13	19
26	38	30	34	24	19	11	15
27	45	31	39	25	21	13	18
28	39	23	28	26	21	13	18
29	33	27	29	27	24	15	21
30	27	15	16	28	26	17	21
December 1	20	4	14	29	19	10	14
2	24	5	16	30	21	4	15
3	29	12	23	31	34	17	24
4	34	24	30				
5	45	24	34	1877.			
6	47	33	38	January 1	24	13	14
7	47	31	39	2	21	8	15
8	40	3	15	3	26	11	21
9	11	—5	5	4	42	19	33
10	37	9	31	5	42	29	36
11	55	28	44	6	43	32	37
12	60	36	48	7	35	13	21

Temperature at Saint Louis, Mo., of winter of 1876–'77—Continued.

1877.		Max.	Min.	Mean.	1877.		Max.	Min.	Mean.
January	8	13	—4	7	February	8	47	36	42
	9	28	1	19		9	50	33	44
	10	35	21	31		10	58	37	48
	11	52	32	40		11	58	42	52
	12	32	14	19		12	52	29	32
	13	27	10	22		13	36	28	33
	14	34	22	31		14	44	30	38
	15	43	23	33		15	53	31	44
	16	23	9	18		16	47	38	40
	17	40	20	35		17	50	34	42
	18	46	35	42		18	66	34	53
	19	50	39	45		19	58	34	37
	20	46	21	22		20	48	27	39
	21	37	19	32		21	65	34	51
	22	37	23	26		22	53	44	47
	23	32	10	24		23	44	33	38
	24	31	19	26		24	35	29	32
	25	48	22	36		25	33	28	31
	26	51	32	39		26	43	28	37
	27	50	31	41		27	48	28	40
	28	57	33	47		28	50	32	43
	29	57	38	49	March	1	47	39	43
	30	65	48	57		2	47	37	39
	31	66	53	59		3	49	18	29
February	1	69	50	59		4	32	14	26
	2	56	44	49		5	40	26	34
	3	48	35	37		6	55	30	46
	4	46	32	39		7	57	36	47
	5	40	28	33		8	55	18	23
	6	49	34	41		9	23	9	18
	7	53	38	46		10	41	16	31

1. HARROWING IN THE AUTUMN.—To appreciate fully the effect on the eggs of harrowing in the autumn, it is necessary to understand in what manner they are affected by freezing and thawing, as well as by exposure.

Experiments to test the effects of alternately freezing and thawing.—The eggs in the following series of experiments were obtained early in November, at Manhattan, Kans., under similar conditions. They were mostly in a fluid state at the time, and none but good and perfect masses were used. They were all carefully placed in the normal position at the surface of the ground, in boxes that could be easily removed from place to place. The experiments commenced November 10, 1876, and ended in April, 1877. During November and December the weather was severe, while during January and February it was largely mild and genial for the season. In March again there was much frost.

The temperature in the office, into which all the eggs when not exposed were brought, ranged during the day from 65° to 70° F., rarely reaching to 75°. During the night it never dropped below 40°, and averaged about 55°.

Experiment 1.—Fifty egg-masses were exposed to frost from November 10 to January 10, and then taken indoors. In twenty days they commenced hatching, and continued to do so for thirty-eight days thereafter.

Experiment 2.—Fifty egg-masses exposed at the same time to frost. Brought indoors on December 10. On December 31 they commenced hatching numerously, and continued to hatch till the 10th of January, 1877, when the remainder were exposed again. The weather being subsequently mild, some hatched on each warm day until the 26th. None hatched thereafter, and upon examination, subsequently, all were found to have hatched.

Experiment 3.—Fifty egg-masses exposed at same time. Brought indoors December 1. Kept there till the 22d without any of them hatching. Exposed again for three weeks, and then brought indoors on the 12th of January. They commenced hatching two days thereafter, and continued till the 29th. Subsequent examination showed them all to have hatched.

Experiment 4.—One hundred egg-pods exposed at the same time, but alternately

brought indoors and exposed again every fourteen days. Some commenced hatching during the second term indoors; others continued during the warm days of the third exposure, and all had hatched by the sixth day of the third term indoors.

Experiment 5.—A lot of one hundred egg-masses alternately exposed and brought indoors every week. During the first four terms of exposure they were continuously frozen, while during the next four the weather was frequently mild enough to permit hatching. They first began to hatch during the fourth term indoors, and continued to hatch, except during the colder days when exposed, until the seventh term indoors, during which the last ones escaped.

Experiment 6.—Many hundred egg-masses kept outdoors the whole time, first commenced hatching March 2, and continued for thirty-eight days thereafter.

Experiment 7.—Many hundred pods kept indoors till December 15, and hatching from November 28 up to that time, were then exposed, and continued to hatch whenever the weather permitted up to April 10.

Experiment 8.—A lot of one hundred pods that had been hatching indoors from November 19 were exposed to frost January 15, and brought indoors again January 28, where they continued hatching till February 10. Every one was subsequently found to have hatched.

Experiment 9.—A lot of one hundred under same conditions as in Experiment 8, up to January 28. They were then exposed again and brought indoors February 16, when they commenced hatching and continued to do so till the 27th. All were found subsequently to have hatched.

Two important conclusions are deducible from the above experiments. First: The eggs are far less susceptible to alternate freezing and thawing than most of us, from analogy, have been inclined to believe. Those who have paid attention to the subject know full well that the large proportion of insects that hibernate on or in the ground are more injuriously affected by a mild, alternately freezing and thawing winter than by a steadily cold and severe one, and the idea has quite generally prevailed that it was the same with regard to our locust-eggs. But, if so, then it is more owing to the mechanical action which, by alternate expansion and contraction of the soil, heaves the pods and exposes them, than to the effects of the varying temperatures. Second: That suspended development by frost may continue with impunity for varying periods after the embryon is fully formed and the young insect is on the verge of hatching. Many persons, having in mind the well-known fact that birds' eggs become addled if incubation ceases before completion, when once commenced, would, from analogy, come to the same conclusion with regard to the locust-eggs. But analogy here is an unsafe guide. The eggs of insects hibernate in all stages of embryonic development, and many of them with the larvæ fully formed and complete within. The advanced development of the locust embryo, frequently noticed in the fall, argues nothing but very early hatching as soon as spring opens. Their vitality is unimpaired by frost.

Experiments to test the effects of exposure to the free air.—The eggs in the following series were obtained at Manhattan, Kans., in November, and all under similar conditions:

Experiment 26.—A large number of egg-masses were thoroughly broken up and the single eggs scattered over the surface of the ground outdoors early in December. By the 23d of February all had perished, and most of them had collapsed and shriveled.

Experiment 27.—A large number of pods were partly broken up and exposed, as in Experiment 26. On the 10th of March the outer eggs were mostly dead and shrunken, but a few of the protected ones were yet plump, the embryon well advanced and apparently sound. Placed in earth they subsequently hatched.

Experiment 28.—A large number of unbroken pods were exposed under similar conditions as in the preceding experiments. By March 10 fully three-fourths of the eggs had perished, and by April 1 all had perished.

Experiment 29.—Fifty egg-masses were kept indoors in an open-mouthed bottle in perfectly loose and dry earth from November 6. Fully eight per cent. of the eggs had hatched by December 28, when hatching ceased, and a subsequent examination showed the rest to have shrunken and perished.

It is very evident from the above experiments that we can do much more to destroy the eggs by bringing into requisition the universally

utilizable air than we can by the use of water, which will be presently considered. The breaking up of the mass and exposure of the individual eggs to the desiccating effects of the atmosphere effectually destroys them, and when to this is added the well-known fact that, thus exposed, they are more liable to destruction by their numerous enemies, we see at once the importance of this mode of coping with the evil.

Harrowing in the autumn, then, or during dry, mild weather in early winter, will prove one of the most effectual modes of destroying the eggs and preventing future injury, wherever it is available. It should be enforced by law, as we shall presently suggest in considering legislative action, whenever the soil in any region is known to be abundantly stocked with eggs. A revolving harrow or a cultivator will do excellent service in this way, not only in the field, but along roadways and other bare and uncultivated places. The object should be, not to stir deeply, but to scarify and pulverize as much as possible the soil to about the depth of an inch. Where the cultivator is used, it would be well to pass over the ground again with a drag or a brush harrow for this purpose. Some of our correspondents have urged, and with some reason, that wherever land can conveniently be prepared to induce the females to oviposit in it, as by plowing and then rolling when the insects are beginning to breed, such preparations should be made. A subsequent harrowing will be the more easy. In practice, this method will not often be adopted, because it will pay only under exceptional circumstances.

We give here a few of the views of correspondents on the subject of harrowing expressed during the past year:

Harrowing has been tried with success, especially when fowls, swine, &c., have been given access to the ground. In one case, a piece of two acres was entirely freed from the eggs in this way.—[Robt. Milliken, Emporia, Kans., September 15, 1877.

Harrowing the ground in the fall is always beneficial; it brings many of the eggs to the surface, where they are picked up by birds and fowls and otherwise destroyed.—[E. Snyder, Atchison, Kans., June 26, 1877.

The reports of the results of this latter method of destruction are conflicting, varying according to the care expended upon the work, the lateness of the season at which it was done, and the accuracy with which the results were noticed.

In cases where new breaking thickly filled with eggs was passed over once or twice with a seeder in November or late in October, a portion of the eggs were left undestroyed, and these, hatching in the spring, the young devoured the grain as fast as it grew. In other cases eggs brought to the surface late in the fall retained their vitality (the young were fully formed in the eggs) during the winter; but afterward, when they had been fully exposed in February and March to alternate heat and cold, without a covering of snow, only a small fraction of them could be hatched. In other cases, where the number of eggs was not excessive, the proportion of eggs left undestroyed after fall harrowing was too small to cause (of themselves) any serious damage in the spring. From all the inquiries that I have been able to make during the season, I am confirmed in the statement made last year that it is desirable to bring the eggs to the surface at the earliest possible moment after there is any assurance that the laying season is over; in other words, they should be exposed to the sun while their contents are still fluid.—[Mr. Allen Whitman, special assistant.

Some eggs were harrowed up during mild weather in winter and greedily devoured by tame fowls. Some egg-masses that were exposed in February mostly hatched.—[G. B. Brown, Guilford, Kans.

Harrowing the ground in the fall is good; every egg-mass that is broken or brought to the top is used up. Last fall was an unusually wet one, and great numbers of eggs were unearthed by the rains, and I will venture to say that of the egg-masses that were so washed out not one ever has or will hatch. Uncovering the egg-masses in the fall is fatal to them all.—[A. H. Gleason, Little Sioux, Iowa, May 21, 1877.

We want to get the young to hatch as soon as possible in the spring, and then go at them with the "hopper dozer" determinedly and unitedly, and we can destroy them. To that end I believe harrowing is to be recommended for several reasons; first, many of the eggs are spoiled by the sun and weather; secondly, the birds can get at them better and devour millions of them; and, thirdly, those that are not destroyed hatch early and can be killed before the vegetation gets too rank, as afterward it is far more difficult to capture them.—[J. I. Salter, Saint Cloud, Minn., June 7, 1877.

I have only one instance of harrowing the ground in fall. My nearest neighbor put in a piece of new breaking with rye, first using seeder and then harrow. The result now stands that the rye is good and but few 'hoppers. The eggs were raked out almost or quite as thickly as the grain sown, and they were much thicker just beneath the loose top soil. The nature of our soil is a clay loam—yellow-clay subsoil.—[John Wise, Nebo, Platte County, Nebr., May 5, 1877.

2. PLOWING.—Next to harrowing this is one of the most generally available means possessed by the farmer of dealing with locust-eggs, and it is well to fully understand how it may be made most effectual in destroying them.

Experiments to test the effects of burying at different depths, and of pressing the soil.—The following series of experiments was made with eggs obtained at Manhattan, Kans., early in November, and similar in condition to those in the first series. Large tin cylindrical boxes, made of different depths, and varying from 4 to 8 inches in diameter, were used; and in order to hasten the result they were kept indoors at the temperature already mentioned. The soil in all the boxes was finely comminuted and kept in uniform and moderately moist condition. It was gently pressed with the fingers, so as to approach in compactness the surface-soil of a well-cultivated garden. In each instance the eggs were placed in the center of the box. A large number of eggs were buried at different depths outdoors where they were under natural conditions of soil-pressure and temperature. The soil was a tolerably stiff yellow clay, and was pretty well compacted by many heavy rains, after the frost was thawed out. The results of the outdoor experiments comport with those made in the boxes. The eggs being placed at every depth from 1 to 18 inches, and each batch covered with a wire screen, the result was accurately determined. All at 1 inch below the surface hatched; about one-third of those at 2 inches managed to escape, and none from any greater depth. Examined May 12, they had hatched down to a depth of 12 inches, and worked their way upward, and horizontally, seldom extending more than 1 inch in the former, or more than 2 inches in the latter direction. Most of those at greater depths were at that time unhatched. In looser soil they would doubtless have managed to push somewhat farther.

Experiment 30.—Ten egg-masses were placed just 1 inch below the surface in the center of a box 4 inches in diameter. The young began to appear January 30, when it was noticed that every one came up at the side of the box, between the earth and the tin, where there was more or less shrinking of the former from the latter. Upon pressing the earth more firmly around the border, the issuing of the young ceased. Upon examining the eggs, March 7, it was found that they had all hatched. A few of the young were still alive, and endeavoring to escape; the rest had died in the effort. They had made no progress upward through the pressed surface, but had pushed horizontally as the looser earth permitted.

Experiment 31.—From ten egg-masses, placed 2 inches beneath the surface, the young commenced issuing from the sides, as in the preceding experiment, January 31. None issued directly through the surface of the soil, and none issued after the border was pressed more firmly to the tin. Subsequent examination showed the soil penetrated in devious directions, but none of the insects had reached higher than within three-quarters of an inch of the surface.

Experiment 32.—Ten egg-masses placed 3 inches below the surface. The young began, January 31, to issue from the sides, as in Experiments 30, 31. Upon pressing the ground more firmly around the borders, none afterward issued, and subsequent examination showed that the young had tunneled the earth in tortuous passages toward the sides, and perished there, without reaching nearer than within an inch of the surface in the middle of the box.

Experiment 33.—Ten egg-masses placed 6 inches below the surface. On February 1 the young commenced to issue, as in the preceding experiments, from the side, and continued to do so till the 4th, when the earth was pressed more closely to the tin. None issued afterward. Subsequent examination showed that some had succeeded in working their way upward through the soil to within 2 inches of the surface; but most had reached the sides, and there collected and perished between the tin and the soil.

Other experiments, made in glass tubes where the movements of the insects could be watched, all produced results similar to those above given; and all point to the conclusion that where the newly-hatched insect has not the natural channel of exit (previously described) which was prepared by the mother, it must inevitably perish if the soil be moderately compact, unless cracks, fissures, or other channels reaching to the surface are at hand.

"The actual experience as to deep plowing under of the eggs is somewhat conflicting, and in some light, dry soils a good number of them will hatch late if turned under a foot; yet, from our own observations, and a vast amount of experience gathered together, we recommend it as profitable. If delayed till spring, it should be done just as the young begin to hatch, as it is then most effectual. The plowing will be effectual according as the soil is porous or tenacious, *and according as the surface is afterward compressed by harrowing and rolling*. From the experiments already recorded, it is obvious that, all other things being equal, a plowing of four to six inches will prove more effectual in spring, if the ground be subsequently harrowed and rolled, than deeper plowing with no subsequent comminution and compression."

The experience prior to 1877 is on record in various publications; but that of 1877 was most valuable, because, in many instances, township meetings were held the previous autumn to provide for combined action in the plowing up of roadsides and other public places where eggs had been laid. As may be seen by Mr. Whitman's report, the good effects of plowing the eggs under deeply was very marked in Minnesota, wherever the work was thoroughly done. Even when turned under to a depth of five or six inches, the hatching, if it occurred at all, was too late to cause any fear. "Eggs plowed under in corn-land were found to be unhatched up to the 21st of June, but when brought to the surface they hatched at once; and, without any question, large numbers of eggs turned under in heavy grounds never hatched at all. At any rate, it ought to be learned from the present year, that, with a good growth of wheat, we have nothing to fear from locusts that come struggling forth during the month of June."

The following experiences of correspondents are worthy of record here:

I plowed my orchard in the last days of March, and last week I was plowing some potatoes and I plowed out a good many 'hoppers, and in two or three minutes they would kick out and jump. I don't know how long they can live in the ground, but I don't think they can get out when they are plowed under.—[C. G. Brooks, Cherryvale, Montgomery County, Kansas, June 16, 1877.

The effect of plowing under the eggs quite deeply at any time before hatching, either in the fall or spring, has been to retard the hatching and give birds and other enemies a better chance to destroy them as they hatched. I think many never see the surface that are turned down with the plow.—[Robt. Milliken, Emporia, Kans., September 15, 1877.

Deep plowing is here the most effectual way of destroying the eggs.—[J. G. McGrue, Audubon, Minn., June 20, 1877.

I and my brother plowed a piece of land last fall that the 'hoppers had laid their eggs in, and not one per cent. hatched out. Time of plowing, September 9; depth of plowing, 6 inches; nature of soil, sandy loam.—[Thomas Nixon, Argyle, Sumner County, Kansas, November 5, 1877.

The land plowed early last fall by my neighbor, Thomas Bennett, was subsequently filled with eggs. He dragged and sowed it with wheat. It is now full of locusts. Mr. A. Burch, another neighbor, plowed late, and he has no locusts. My brother's farm was one-half plowed early, the other half late. The former hatched many locusts, the latter none.—[Seth Kenny, Morristown, Minn., June 9, 1877.

We plowed our land before many of the 'hoppers had hatched. It is high, rolling land, with considerable sand, and considerably worn from continued cropping for 19 years. We plowed about 15th of May. The largest hatch of the 'hoppers in any one day was May 27. They continued to hatch in considerable quantities up to June 10. Some few hatched after this date. But the most disagreeable part of it remains to be

told. June 21 (the season was late for corn) we commenced to cultivate our corn, and immediately the young 'hoppers came out by millions. We have about twenty-four acres of corn in one field, and in the aggregate they make an "exceeding great army." Six acres of this corn was on timothy soil, that was very full of eggs.—[*Ibid.*, July 2, 1877.

Plowing, when properly done, is almost perfect destruction to the eggs.—[J. W. Bagby, Tabor, Clay County, Kansas, May 10, 1877.

So far as I can judge from my own experience and from observation, plowing the eggs under in the spring has destroyed most of them.—[T. C. Wells, Manhattan, Kans., June 27, 1877.

Plowing under only preserved the eggs to be hatched whenever a favorable opportunity presented.—[E. Snyder, Atchison, Kans., June 26, 1877.

Yesterday I examined a field closely that had been plowed under in early spring. I found thousands of nests of eggs hatched out and the young ones dead, having been unable to work their way out of the ground. There are many such instances here.—[Saml. Aughey, Lincoln, Nebr., May 4, 1877.

Believing it to be the duty of every good citizen to contribute all the information he may possess in relation to the destruction of the locusts, I will send you the practical experience of an observing farmer in this vicinity. In the spring of 1875, when the grasshopper committed such ravages in Western Missouri, William R. Hornbuckle relates that he had occasion to break up, for corn, a field that was in clover the year previous (1874), upon which the locust-eggs were more than usually thick. He plowed deeply the first of April and turned the eggs under so deep that they never hatched, or, if they did hatch, he never saw the locusts afterward. He thinks he plowed some eight or nine inches deep. The use of cultivators never disturbed the eggs. He examined the ground often during the season and found only the old eggs and no 'hoppers. One portion of the clover-field he failed to break until the eggs were hatched. In this the young locusts came so thick as to make the ground black, and while they were yet small he turned them under like the eggs, in the first instance. He saw very few of them afterward.—[Jno. B. Wornall, Kansas City, Mo., January 23, 1877.

If the eggs are plowed under very deep in the fall, I believe many will fail to hatch or the young will not reach the surface when hatched. They should be thrown under about six inches in sandy, loose soil. Spring plowing has done but little if any good. It only causes them to hatch later in the season.—[A. H. Gleason, Little Sioux, Iowa, May 21, 1877.

Deep fall plowing seems to have destroyed many of the eggs. Every piece of breaking that was not fall-plowed suffered severely; that which was plowed and harrowed in the fall did not suffer much.—[W. J. Newell, Athol, Iowa, July 2, 1877.

Spring breaking of our lands remained perfectly good till upturned by second plowing one month to six weeks later.—[Jas. Moore, Bastrop, Tex., May 8, 1877.

Deep plowing retarded hatching. After all others were hatched the deeply plowed land was stirred, which brought on a new crop.—[G. B. Brown, Guilford, Kans.

Plowed in October, 1876; sowed to rye in November, on bottom land, but gravelly; cut the rye second week in July (prematurely) because of drought. As soon as the rye was cut the locust-eggs hatched in large quantities.—[Experience of M. K. Leverson, of Leverson's ranch, Colorado. From all we can learn the eggs were not turned under deeply.]

3. IRRIGATION.—This is feasible in much of the country subject to locust ravages, especially in the mountain regions, where, except in exceptionally favorable locations, agriculture can be successfully carried on only by its aid, and where means are already extensively provided for the artificial irrigation of large areas. Where the ground is light and porous, prolonged and excessive moisture will cause most of the eggs to perish, and irrigation in autumn or in spring may prove beneficial. Yet the following experiments prove that it is by no means as effectual as is generally believed, and as most writers have assumed to be the case.

Experiments to test the influence of moisture upon the eggs.—The following series of experiments was made with eggs also brought from Manhattan, Kans. They were dug up in December, and were sound, and much in the same condition as those in the preceding series.

The water in all but the last three, or Experiments 23, 24, and 25, was kept in the office at the temperature already stated, and changed only when there was the least tendency to become foul. In the alternate submergence and draining, the eggs were submitted to the most severe

hygrometric changes, the warm atmosphere of the room having great drying power.

Experiment 10.—Ten egg-masses kept under water in-doors from December 5 to December 26, 1876, the water becoming quite foul. They were then removed to earth and kept in a hatching temperature. They commenced hatching January 11, 1877, and continued to do so till February 5—all having hatched.

Experiment 11.—Twenty egg-masses kept under water in-doors from December 26, 1876, till January 2, 1877; then left dry till the 9th; then submerged again till the 16th, when they were drained again. On the 20th eighteen young hatched, and others continued hatching till the 23d, when they were submerged again. From the 26th to 30th a few hatched under water, successfully getting rid of the post-natal pellicle, and living for some hours afterward in the water. On the 30th they were drained again, and continued to hatch. On February 6 they were again immersed, and continued to hatch on the 7th. On the 15th, 22d, 29th, and March 7 they were alternately drained and immersed; but none hatched after February 7, and the remainder proved upon examination to have been destroyed, most of them being quite rotten.

Experiment 12.—Two egg-masses taken from the lot in experiment 11, on February 7, and placed in moist earth. Every egg subsequently hatched.

Experiment 13.—Two egg-masses taken from the lot in experiment 11, on February 22, and placed in moist earth. All hatched.

Experiment 14.—Twenty egg-masses alternately immersed and drained every two weeks from December 26 till March 6. None hatched, but three-fourths of the eggs were at this date sound, the embryon full formed and active as soon as released, but pale, and evidently too feeble to burst the egg-shell. The rest were killed and more or less decomposed.

Experiment 15.—Two egg-masses, after immersion for two weeks, were placed in moist earth. They began hatching twenty-two days afterward, and continued to do so for six days. It was subsequently found that only seven out of forty-eight eggs had collapsed and failed to hatch.

Experiment 16.—Two egg-masses immersed for two weeks and drained for two weeks; then placed in moist earth. Six days afterward they commenced hatching, and continued to do so for two days. Subsequently examined, twenty-eight out of fifty-four eggs had perished.

Experiment 17.—Two egg-masses alternately immersed, drained, and immersed again every two weeks, were placed in moist earth. They commenced hatching two days afterward, and continued to do so for twelve days. Upon subsequent examination, twenty-three out of fifty-two had perished.

Experiment 18.—Twenty egg-masses immersed from December 26, 1876, to January 16, 1877; then drained till February 6; then immersed till February 27; then drained again. On February 3, while dry, they commenced hatching numerously, and a few continued for two days to hatch while immersed. An examination, March 7, showed about half of them still alive, the rest rotten. On March 27 they were drained again, but none subsequently hatched—all having rotted and dried up.

Experiment 18*a*.—Two masses in same conditions as in experiment 18 till February 27 were placed in moist earth and all the eggs hatched March 7–12.

Experiment 19.—Twenty egg-masses immersed from December 26, 1876, to January 23, 1877; then drained till February 20; then submerged again. They commenced hatching on the 6th of February, and continued two days after the second submergence. On the 7th of March but about 5 per cent. had rotted. On March 20 they were drained again, but none subsequently hatched, except 5 eggs from two pods at once placed in earth.

Experiment 20.—Two egg-masses immersed for four weeks; then drained for two weeks; then immersed for one week; then placed in moist earth. They commenced hatching seven days afterward, and continued to do so for six days. Subsequently examined, one of the masses was rotten; the eggs in the other had all hatched.

Experiment 21.—Twenty egg-masses kept from December 26, 1876, in earth saturated with moisture. On February 23, 1877, they commenced hatching, and continued to do so till March 7, when all were found to have hatched, except one pod, which was rotten.

Experiment 22.—Twenty egg-masses, alternately placed every five days, from December 26, 1876, in earth saturated with moisture and in earth which was very dry. Commenced hatching February 14, and continued till March 7, when, upon examination, all had hatched, except nine of the pods, which were rotten.

Experiment 23.—Twenty egg-masses immersed and exposed out-doors December 26, 1876. From that time till April 9 the water was frozen and completely thawed at nine different times, the vessel containing them, which was of glass and admitted the sunlight, several times breaking. The changes were as follows: Frozen till January 10; then thawed till the 12th; then frozen till the 18th; then thawed till the 20th; then frozen till the 26th; then thawed till February 20; then partly frozen till the 22d;

then thawed till the 26th; then frozen till the 27th; then thawed till March 5; then frozen till March 10; then thawed till March 15; then frozen till the 16th; then thawed till the 24th; then frozen till the 25th. Examined on the 7th of March, only one pod was found rotten; the others apparently sound. On the 9th of April all with the exception of twelve eggs were found rotten, the masses having become disintegrated and the eggs for the most part lying singly at the bottom.

Experiment 24.—Two egg-masses under same conditions as in experiment 23 till February 9, when they were brought in-doors and placed in earth. One was dried up on the 16th; the other commenced hatching on the 27th, and when examined on March 7 all the eggs in it were found to have hatched.

Experiment 25.—Two egg-masses under same conditions as in experiment 23 till February 27, when they were placed in earth in-doors. Examined March 7 they were found sound, and near the hatching point. On March 20 they commenced hatching.

Experiment 25*a*.—Two egg-masses under same conditions as in experiment 23, up to March 6, were then placed in earth in-doors. They commenced hatching March 23, and continued till April 3. Subsequently examined, but eight out of the fifty-four eggs were shrunken and dead.

Experiment 25*b*.—Two egg-masses under same conditions as in experiment 23, up to March 27, were then placed in earth, as above. April 14–20 ten hatched. Subsequently examined, the rest were found rotten.

Experiment 25*c*.—The twelve eggs remaining April 9 from experiment 23 were placed in earth. Five out of the twelve hatched April 20–26. The rest were subsequently found rotten.

These experiments establish a few facts that were somewhat unexpected. The insect is a denizen of the high and arid regions of the Northwest, and has often been observed to prefer dry and sunny places, and to avoid wet land, for purposes of ovipositing. The belief that moisture was prejudicial to the eggs has, for these reasons, very generally prevailed. The power which they exhibit of retaining vitality, and of hatching under water or in saturated ground, is, therefore, very remarkable—the more so when viewed in connection with the results obtained in the succeeding experiments. That the eggs should hatch after several weeks' submergence, and that the young insect should even throw off the post-natal pellicle, was, to us, quite a surprise, and argues a most wonderful toughness and tenacity. After they had been dried and soaked for over six weeks, under conditions that approach those of spring, we found a good proportion of the eggs to contain the full-formed and living young, which, though somewhat shrunken, and evidently too weak to have made an exit, were still capable of motion. The water evidently retards hatching. An examination of the submerged eggs that remained unhatched long after others had hatched, which had been under similar treatment up to a certain time, and then transferred to earth, showed all the parts to be unusually soft and flaccid. Yet, when once life has gone, the egg would seem to rot quicker in the water than in the ground.

The results of experiments 23–25*c* prove conclusively that water in winter-time, when subject to be frozen, is still less injurious to the eggs.

Altogether, these experiments give us very little encouragement as to the use of water as a destructive agent; and we can readily understand how eggs may hatch out, as they have been known to do, in marshy soil, or soil too wet for the plow; or even from the bottom of ponds that were overflowed during the winter and spring. While a certain proportion of the eggs may be destroyed by alternately soaking and drying the soil at short-repeated intervals, it is next to impossible to do this in practice during the winter season as effectually as it was done in the experiments; and the only case in which water can be profitably used is where the land can be flooded for a few days just at the period when the bulk of the eggs are hatching.

4. Tramping.—In pastures or in fields where hogs, cattle, or horses can be confined when the ground is not frozen, many if not most of the locust-eggs will be destroyed by the rooting and tramping.

5. COLLECTING.—The eggs are frequently placed where none of the above means of destroying them can be employed. In such cases they should be collected and destroyed by the inhabitants, and the State should offer some inducement in the way of bounty for such collection and destruction. Every bushel of eggs destroyed is equivalent to a hundred acres of corn saved, and when we consider the amount of destruction caused by the young, and that the ground is often known to be filled with eggs; that, in other words, the earth is sown with the seeds of future destruction, it is surprising that more legislation has not been had looking to their extermination.

One of the most rapid ways of collecting the eggs, especially where they are numerous and in light soils, is to slice off about an inch of the soil by trowel or spade, and then cart the egg-laden earth to some sheltered place where it may be allowed to dry, when it may be sieved so as to separate the eggs and egg-masses from the dirt. The eggs thus collected may easily be destroyed by burying them in deep pits, providing the ground be packed hard on the surface. In the thickly-settled portions of Europe, where labor is abundant and cheap, this method may be adopted with some advantage, but it will scarcely be employed in this country, except as a means of earning a bounty, when, in the more thickly-settled sections, it will prove beneficial and give employment to young people and others who have nothing else to do.

DESTRUCTION OF THE YOUNG OR UNFLEDGED LOCUSTS.

It is with some degree of pride that we point to the fact that this part of the locust problem is solved. The experience of 1877 has added much to our knowledge of the practical and feasible ways of destroying the young locusts, and has firmly established the fact which we had previously maintained, that, with proper means, effort, and co-operation, the farmer, in the more fertile and settled portions of the country liable to their injury, may successfully cope with them; that, in short, he can protect his crops against them with about as little labor and expense as he must annually employ to protect most of these same crops from weeds. Farmers themselves were surprised at what could be accomplished by well-directed, intelligent effort; and it was the almost universal testimony that there need be, in future, no serious fear of the young insects, even where little effort has previously been made to destroy the eggs. In the destruction of the young, no methods that will not sweep them away in wholesale fashion have any value for our western farmers, however valuable they may be to the owner of a small flower or truck garden. It is for this reason that we have been able to profit so little by European methods, and have had to invent means suitable to our broad western fields and the extensive nature of our farming operations. The best that most European authors can advise is the killing of the insects with flattened implements or brush; while Gerstäcker and other writers devote page after page to prove the superiority over other methods of catching the insects with hand-nets—a method which, while doubtless of some utility in dense German settlements, would prove absolutely futile on our large and scattered prairie-farms and against the excessive numbers of the pests which our farmers have to deal with. While, therefore, we shall mention all available means that have been or may be employed, we shall devote more especial attention to those which are useful in a broad and general way in the field.

Experience has shown that the results of any particular measure will vary in different regions, dependent, to some extent, upon the nature of

the soil, the condition of the crops, and the general characteristics of indigenous vegetation. Circumstances may also render some particular measure available and profitable to one farmer where it would be unprofitable to another. For convenience, the means of accomplishing the desired result may be classified into: 1. Burning. 2. Crushing. 3. Trapping. 4. Catching. 5. Use of destructive agents.

1. BURNING.—This method is, perhaps, the best in prairie and wheat-growing regions, which compose the larger part of the area subject to devastation by this locust. In such regions there is usually more or less old straw or hay which may be scattered over or around the field in heaps and windrows, and into which the locusts, for some time after they hatch, may be driven and burned. During cold or damp weather they congregate of their own accord under such shelter, when they may be destroyed by burning without the necessity of previous driving. Much has been said for and against the beneficial results of burning the prairies in the spring. This is chiefly beneficial around cultivated fields or along the roadsides, from which the locusts may be driven, or from which they will of themselves pass for the shelter the prairie affords. Scarcely any eggs are laid in rank prairie, and the general impression that locusts are slaughtered by myriads in burning extensive areas is an erroneous one, at least in the Temporary region.

In burning extensive prairies after the bulk of the locusts hatch, the nests and eggs of many game-birds are destroyed; but as the birds themselves escape destruction on the wing, they may and do return and nest again, while, on the contrary, many injurious insects, like the chinch-bug, for instance, are killed; so that, even leaving the locust question out of consideration, the burning proves beneficial by exterminating other noxious insects, and has some advantages from an agricultural point of view.

As locusts disperse more and more from their hatching-grounds into the prairie as they develop, burning the grass in spring is beneficial in proportion as it is delayed.

Machines for burning have been used in several localities with considerable success. Mr. J. Hetzel, of Longmont, Colo., has employed a machine drawn by horses. It is 12 feet long, from 2 to 2½ feet wide, made of iron, and set on runners 4 inches high. An open grate on the top of the runners is filled with pitch-pine wood, a metal sheet covering the grate to keep the heat directed downward. The grate is generally made with a net-work of heavy wire, such as telegraph wire. Two men and a team can readily burn from 10 to 12 acres a day and kill two-thirds of the insects, but for this it requires a hot fire.

Mr. C. C. Horner gives a more detailed description, in the *Colorado Farmer*, of a machine of somewhat similar construction:

> It consists of three runners, made of 2 by 4 scantling, 3 feet in length, to be placed 6 feet apart, making the machine 12 feet wide; runners to be bound together by three flat straps or bars of iron (the base being 12 feet long). Across the top, bars of iron hold the runners firmly together, and form a frame across which wire can be worked to make a grate to hold fire. The upper part of the runners should be hollowed out so that the grate may slide along within two inches of the ground. A sheet-iron arch should be set over this grate to drive the heat downward. This machine is very light, and can be worked with one horse. Pitch-wood is best adapted to burning, and can be chopped the right length and size and left in piles where most convenient when needed. This machine is intended to be used when the little 'hoppers just make their appearance along the edge of the grain, going over the ground once or twice each day, or as often as necessary to keep them killed off. The scorching does not kill the grain, but makes it a few days later. This is certainly the cheapest, as well as the most effectual, manner of getting rid of this pest.

Hand-burners, consisting of any form of pan or grate, or wire sieves,

with handle attached, to hold combustible material, will do excellent service in gardens and small inclosures.

There is another method by which large numbers of locusts can be burned, consisting merely of a bundle of rags or tow, which, after being attached to long wire or iron rods and saturated with kerosene, can be ignited and carried over the field. This method has been quite satisfactorily used in Colorado. A stout wire, say forty feet long, is thoroughly enveloped in rags soaked in coal-oil. A small wire is wound around the rags to keep them in place, and the simple device is complete. Two men carry this rope, after setting fire to the rags, across the field to and fro until the fuel is exhausted, and as it is not necessary to pass over the same ground more than once or twice, a large field of grain can be thus protected during the half hour or so that the rags burn. The effect is that of a miniature prairie fire.

Under this head may be mentioned a machine constructed by Mr. Kimball C. Attwood, of Syracuse, N. Y. (patent No. 193,105, dated July 17, 1877), for destroying the insects by sulphur fumes. The machine is too expensive and complicated to come into general use, especially as it is less effectual than some of the simpler ones. The principle of the invention consists in attaching to the axle of the machine a light stove, and connecting the same with a blower or bellows by means of a tube. Surmounting this tube, and close to the stove, is situated the hopper for the reception of the destroying compound (sulphur), while the lower section of the stove is connected with an escape-pipe having attached thereto a series of flexible tubes, by means of which the fumes of the compound are carried to the ground. Attached by suitable means to the rear of the axle is a horizontal bar, to which is secured the apron or cover designed to prevent the escape of the fumes after being delivered by the flexible tubes.

Other machines have been constructed, having troughs or wire receptacles attached, in which the locusts are deposited and ultimately destroyed by means of sulphur fumes or hot water. But as these remedies are applied by hand, they will be classed under the head of *Catching*, &c.

2. CRUSHING.—To destroy locusts satisfactorily by this means can only be advantageously accomplished where the ground is smooth and hard. Where the surface of the ground presents this character, heavy rolling can be successfully employed, especially in the mornings and evenings of the first eight or ten days after the newly-hatched young have made their appearance, as they are generally sluggish during those times, and huddle together until after sunrise. It is also advantageously employed during cold weather at any time of day, since the young when the temperature is low seek shelter under clods, &c. In various parts of Europe and Asia, flat, wooden, spade-like implements are extensively used for crushing young locusts. Large brushes, weighted down with stone and drawn by horses, were in some instances used last summer, but with less success than was anticipated.

Several machines, most of them patented, were for the first time used during the past year to further the crushing of the young, and while none of them are likely to take the place of the more simple methods of catching, to be presently described, we nevertheless feel that it devolves upon us to describe some of them. That represented on Pl. I was invented by Mr. George B. Drum, of Syracuse, Nebr. (patent No. 187,258, dated February 13, 1877). Fig. 7 is a vertical section on line *x*. Fig. 6 is a plan view with a part of the top removed, showing the mechanism.

To the front of the principal frame A of the vehicle is attached, by a hinge or movable joint, a scraper-frame, B. The front edge of B is carried along or near the ground

for the purpose of collecting and starting the insects from the ground. Within the frame B are two rolls B^1 B^1, carrying an endless apron, B^2, of canvas or other flexible material. On B^2 are secured one or more strips of wood or metal, B^3, the purpose of these strips B^3 being to keep the canvas straight, and carry the insects forward upon the apron, and prevent their rolling out and escaping. The rolls B^1 and apron B^2 are driven by a belt from one of the wheels A^3 of the vehicle. Upon the frame A is secured a brush, A^1, to sweep the insects and drive them toward the rolls C and also to prevent them from being carried around with the apron B^2. Upon the frame A, and immediately in the rear of the brush A^1, are placed two or more crushing-rolls, C C, of wood or metal. These rolls C C run in boxes, connected by the spring *c* for the purpose of giving the rolls C C a yielding or elastic pressure upon each other. The rolls C C are driven by gearing from one of the wheels A^3 of the vehicle, and in such direction that the insects passing over the brush are drawn through the rolls C C and killed, falling upon the ground, or if it is desired to collect the insects for any purpose, a bag may be attached to the frame A, by hooks or otherwise, below the rolls C C. Upon the frame A are screwed, by means of springs or elastic connections *a*, two scrapers, A^2, of metal or wood, which, bearing upon the surfaces of the rolls C C, serve to keep them clean and prevent the insects from being carried around them and clogging the machine. To the top of the frame A is secured a light frame or top, E, of wood or metal, covered with the same or with canvas, and having two side wings, E′ E′, also of canvas. The side wings E′ are also secured to the frame of the apron B^2, forming with that and with the top E a hopper of entrance to the rolls C C of large area, to catch the insects and prevent their flying over the machine and escaping. The wings E′ are also attached to the shafts D D or to the harnesses of the horses, to assist in spreading and enlarging the area of the hopper. The frame A is carried upon two wheels, A^3 A^3, which have projections upon their periphery to give them the necessary driving-power required by the rolls B and C. To each side of the frame A are secured brackets *a′*, which extend back and are attached to the outer end of axles of A^3 A^3. Upon the brackets *a′* are pivoted shafts D, by means of which horses can be harnessed to the vehicle for the purpose of drawing it, the pivots *d* giving the horses the necessary freedom and independence of motion, and also allowing the side wings E′ to be drawn out or spread out by the action of the horses.

Another is that invented by Mr. Michael H. Simpson, of Boston, Mass. (Patent No. 198,420, dated December 18, 1877.) Pl. II, Fig. 1, represents a perspective view of the machine; Pl. II, Fig. 2, a sectional view of the same as shown in the preceding; and Pl. II, Fig. 3, a sectional view of the same arranged for the removal of the insects.

The invention consists, as a whole, in a receptacle for insects, composed of a platform adapted to be drawn or propelled along the surface of the ground, and a flexible hood or cover located on said platform. The receptacle thus formed is adapted to be opened at its front and held open by the draught which moves the apparatus, and to be automatically closed at its front when the apparatus stops; and the receptacle is adapted to be opened at its rear for the removal of the insects after they have been killed by being crushed against the platform.

In the drawings, A represents the grasshopper catcher or receptacle, which is composed of a rigid platform, *b*, and a flexible hood or cover, *c*, located thereon. The platform *b* is mounted on trucks *d d* at its rear side, and has draught-ropes *e e* attached to its forward side, said ropes being adapted for attachment to a horse. The platform is, preferably, from five to seven feet long, and is composed, preferably, of boards, making a tight flooring, and resting on transverse cleats *g g*, the forward ends of which are rounded and rest upon the ground. The forward side of the platform is provided with a downwardly-inclined metallic flange or scoop, *h*.

The hood or cover *c* is composed, preferably, of coarse bagging or other textile or flexible material, and is attached firmly to the ends of the platform, preferably by means of metallic strips, *i*, which are screwed to the platform, the ends of the cover being interposed between the platform and the strips *i*.

j j represent parallel inclined standards, which are rigidly attached to the front side of the platform, and project upwardly and outwardly therefrom, the standards being, preferably, portions of the strips *i*, as shown in Fig. 1.

k represents a bar, which is somewhat longer than the platform *b*, and is adapted to slide up and down on the standards *j*, the bar being provided with slots, through which the standards pass. The forward edge of the hood or cover *c* is attached in any suitable manner to the bar *k*, so as to rise and fall with the latter. The bar *k* is connected to the draught-ropes *e* by short ropes *e′*, which pass through orifices in the upper ends of the standards *j*, and are so arranged that the draught which moves the apparatus will draw the bar upwardly, so that the receptacle is held open, as shown in Figs. 1 and 2, while the apparatus is in motion. When the draught ceases and the apparatus stops, the bar *k* falls, and thus automatically closes the receptacle, as shown in Fig. 3. I prefer

to employ a spring, *l*, to facilitate the descent of the bar *k*, this spring being attached at its ends, preferably, to a stationary object near the rear edge of the platform and to the under side of the hood or cover near the forward edges thereof, as shown in Figs. 2 and 3. This spring, however, may not be necessary when the bar is sufficiently heavy to descend readily by its own weight.

It will be seen from the foregoing that when the apparatus is put in motion the front of the receptacle is automatically opened, and the grasshoppers or other insects on the surface of the field over which it is drawn are gathered or "scooped" into the receptacle.

I provide the rear side of the receptacle with a rigid frame, *m*, to which the hood *c* is attached. This frame incloses a sheet of fine netting, *n*, which forms a reticulated bar rier at the rear of the receptacle, and allows the air to pass freely through the receptacle when it is in motion, but arrests and prevents the escape of the insects.

Another machine that may be mentioned in this connection is that invented by Mr. Charles Hoos, of Arago, Nebr. (Patent No. 187,855, dated February 27, 1877.) In the accompanying illustrations, Pl. II, Fig. 4, represents a top view of the machine; Pl. II, Fig. 5, is a vertical section of the same taken through the line *x x*; and Pl. III, Fig. 1, is a side view. The following detailed description illustrates the construction and working of the machine:

A are the wheels, one of which revolves upon an axle attached to the frame B and the other is rigidly attached to its axle, which revolves in bearings attached to the frame B. To the frame B is attached the platform C, to the front of which are attached a number of guards or fingers, D, which are curved upward, and are designed to enable the machine to pass over obstructions, and to cause the grasshoppers to rise from the ground and fall upon the platform C.

The platform C is grooved or rabbeted, as shown in Pl. II, Fig. 5, and is made highest in the center, and declines toward the front and rear, that the grasshoppers may be crushed against the shoulders of said rabbets or grooves by the cross-bars E, attached to the endless belts F. The cross-bars E are rounded off upon their forward corners, so that they may pass over the grooves or rabbets of the platform C. The endless belts F pass over pulleys G, attached to a shaft, H, the journals of which work in bearings in the forward parts of the side boards of the platform C, and over pulleys I, attached to a shaft, J. The journals of the shaft J revolve in bearings in the rear parts of the side boards of the platform C, and to one of said journals is attached a gear-wheel, K, the teeth of which mesh into the teeth of the gear-wheel L, attached to the journal of the roller M. To the journal of the roller M is also attached a gear-wheel, N, the teeth of which mesh into the teeth of the gear-wheel O, attached to the revolving axle of the wheel A. The teeth of the gear-wheel N also mesh into the teeth of the gear-wheel P, attached to the journal of the roller Q, placed parallel with the roller M. The rollers M Q are placed at the rear edge of the platform C, so that any grasshoppers that may not be killed by the cross-bars F may be crushed by and between the rollers M Q.

The journals of the forward roller M revolve in stationary bearings attached to the frame B, and the journals of the rear roller Q revolve in movable bearings, which are held forward by springs, R, so that the said roller Q may adjust itself according to the number of grasshoppers passing through the machine.

To the frame B are attached scrapers S, to scrape off the crushed grasshoppers from the rollers M Q. To one of the forward corners of the frame B is hinged the end of the draw-bar T, to the forward end of which is hinged the tongue U. The draw-bar T is strengthened against side draught by the brace V, the forward end of which is attached to the forward part of the said draw-bar T, and its rear end is attached to the frame B near its other forward corner.

To the draw-bar T is attached a lever, W, which extends back into such a position that it may be conveniently reached and operated by the driver from his seat to raise and lower the forward edge of the platform C. The lever W may be secured in place, when adjusted, by catches attached to the frame B or to the side board of the platform C. The draw-bar T is supported by a small caster-wheel, X, attached to it.

To the other corner of the frame B is attached a guard-board, or shield, Y, to prevent the grasshoppers from escaping, and to cause them to fall upon the platform C. Z is the driver's seat, the standard of which is attached to the frame B, and is provided with rests for the driver's feet.

We witnessed the working of a machine invented by Mr. T. K. Hansberry, of Padonia, Kans. (Patent No. 188,359, dated March 13, 1877), intended to crush the insects by means of movable wooden bars. It does not prove very successful, however, except on the very smoothest

ground. Pl. III, Fig. 2, is a top view, when mounted on wheels or runners; Pl. III, Fig. 4, represents the front. Pl. III, Fig. 3, is a sectional view of the machine when on runners, with knives or bars attached; and Pl. III, Fig 5, shows the slide attached, close to the axle, to close the angle formed at the side by the ground and the knives or bars when the machine is mounted on wheels.

The invention consists in the novel construction and arrangement of a system of knives or bars attached by one end on a pivot or hinge so as to hang at an angle from a suitable frame, while their opposite ends drag freely on the ground, accommodating themselves to the inequalities of the surface, and, as the machine moves forward, crushing and destroying the insects (the frame may be mounted on wheels or on runners, as shown by Fig. 2); also, in the slide or cover, Fig. 5, used, when the machine is mounted on wheels, to close the angle between the axle and the knives or bars laterally, and in other details of construction hereinafter claimed.

a are the knives or bars, which may be constructed of wood or iron or of any other suitable material. Fig. 2, as already stated, shows the machine ready for operation. A section of the cross-bar *i* of the frame in front is cut away to show in what manner the knives or bars may be attached to the frame *h h*. The dotted lines *x x* indicate the place of the runners when the machine is to be operated without wheels. The rods *b' b* end with a hook, to which the draught is applied. To each of these hooks a horse is to be attached. The animals' heads are to be separated by a jockey-stick, so as to cause them to walk a little outside and in front of the line of the wheels or the runner. The animals will thus be separated from 12 to 15 feet, and even 18 feet, according to the width of the machine and its consequent destructive capacity. Each horse will be covered from the back down to the feet on the outside with a canvas cover to be attached to the harness. This canvas will extend to the rear and be connected to the canvas wings *c c*, as shown in Fig. 4 of the drawing. When the horses are covered in this manner and attached to the machine as described, the insects will be gathered and forced toward the center between the horses as the machine advances, where they will be caught and crushed by the knives or bars *a*, or cut to pieces when these bars are armed with steel blades at the ends. The hood or dash *d*, Fig. 3, is placed at the extreme front, above the throat *s*, after the manner of a dash on a one-horse sleigh, to catch any insect that might attempt to take wing as the machine moves forward. In attempting to rise they will come in contact with the hood or dash and be thrown to the ground, where they will be destroyed by the advancing knives or bars. The dash or hood may be made of wood, tin, sheet-iron, or any suitable material—even canvas may be used. To prevent the escape of the grasshopper laterally or at the side through the angle or space formed by the bars and the ground when the machine is mounted on wheels, the slide or cover *e*, Fig. 5, is employed attached to the axle *f* with the slot *t*. The slide or cover may be jointed, as shown in the figure, or in a single piece. By being jointed it will have a single motion up and down, thus accommodating and adjusting itself to the inequalities of the ground. The upright parts of the frame *h* are held in position by cross-pieces *i*, and in front is a cross-beam, *k*, which support may carry canvas wings *c c*.

It will be readily understood that when my device is used without wheels it is supported upon runners or parts *h*, in which case the slide *e* is not used, but when used upon wheels *m* the slide *e* fills up the space otherwise occupied by the runners *h* and prevents the escape of the insect laterally. In the rear of the machine is a pivotal wheel, *n*, which supports a portion of the weight of the frame and renders the machine easily turned in any direction.

It will be evident that the knives or bars *a* may be greatly modified or changed in construction without departing from the spirit of my invention, as, for instance, they might be armed with steel blades at their bearing on the ground to cut up as well as crush the insects. They might be hinged in groups or in sections. Sufficient weight may be given to each particular knife or bar by a spring or by loading them. It is believed they should be pivoted, as this will give the heaviest bearing at the point of contact on the ground.

As the device is drawn along either on wheels or on runners, as may be most convenient, and according to the particular mode of construction, the insects are gathered into the space between the horses and between the runners *h* or the slide *e*, where they are crushed and destroyed by the knives or bars *a*, the knives or bars also accommodating themselves to the configuration of the ground, easily passing over obstructions, and rendering it almost impossible for the insect to escape destruction. The knives or bars *a* are held in place by a rod, *g*, passing through a hole in the ends of each, the rod passing through the sides of the frame *h h*, in which it is secured by means of suitable fastening.

Mr. Elisha Kenworthy, of Walnut, Iowa, has invented a machine (Patent No. 186,970, dated December 5, 1876) which can be placed un-

der this class of machines. Pl. III, Fig. 7, presents a vertical section of the invention, and Pl. III, Fig. 6, a plan view of the same. The following description will explain the parts and operation:

a represents a suitable trough, made of any desired length, width, or material, and which has a number of slots made across its bottom. This trough is designed to be placed across the front of the reaper platform, so as to be in line with the pitman, and which has a supporting-wheel, *c*, on its outer end, to enable it to run smoothly over the ground. Working back and forth in this trough, operated by the pitman, is the sickle-bar *d*, which likewise has a number of slots or holes through it, but wider than the slots in the bottom of the trough. This sickle may be made of one single piece or two horizontal pieces, and have cross-bars secured to them, the cross-pieces being beveled on their under sides, and the sides of the slots in the bottom being similarly beveled on their under edges. The rear side of the trough is higher than the front, is inclined backward, covered with sheet-metal, and has hinged to it the inclined platform *e*, which is also covered with sheet-metal, so as to cause the grasshoppers to slide down into the trough. This platform is held in position by the spring-rod *g*, which has its rear end fastened to the top of the brace *h*, which brace is fastened to the platform or some other support. The spring is used to impart a vibratory motion to the platform as the machine is drawn along, so as to shake the 'hoppers down as fast as they light upon its front. As rapidly as the 'hoppers fall into the trough they are crushed to death by the rapid reciprocations of the sickle, and then forced out of the bottom of the trough through the openings.

In using my device the cutter-bar or blade is disconnected from its pitman, so that it will no longer operate when the machine is in motion, and then my device, as above described, is placed upon the front edge of the platform, secured in position, and its sickle-bar connected to the pitman. When the mowing or reaping machine is drawn over the ground the motion of the machine causes the bar *d* to reciprocate back and forth and kill the insects as fast as they fall into the trough.

Numerous communications upon this subject have been received, some of which, if not all, are or may have been successful on a small scale. Others, if carried out, and the contrivances built and given a fair trial, might be of especial benefit.

Mr. J. C. Melcher, of O'Quinn, Tex., constructed one which he describes as follows:

It is constructed on the hand lawn-mower style, mounted on light wheels, a disturbing rim, 8 or 10 feet long, passing low over the ground to stir the 'hoppers up. Just behind the disturber are two sheet-metal rollers, one of which drives an endless band. As soon as the 'hoppers jump over the disturber, the band catches them and crushes them between the rollers. The rollers, being of sheet-iron, are elastic enough to press uniformly at any given point. A rack of wire web or cloth ascends over the top of the machine to prevent the 'hoppers from escaping. It is operated by two men pushing the machine before them.

Mr. John Wise, of Nebo, Platte County, Nebraska, says (in a letter dated May 26, 1877) "a good machine can readily be made by having two revolving rollers mounted on wheels, the rollers to be four or six inches above ground, so arranged, if need be, to be adjusted either higher or lower, the upper to revolve on the top of the lower," &c. To a contrivance of this sort handles could be attached for pushing; and with the addition of a frame covered with cloth or muslin projecting forward and outward.

In addition to the preceding contrivances for crushing locusts is one invented by Mr. F. Peteler, of Minneapolis, Minn.

Pl. IV represents a front view, and Pl. V, Fig. 1, a side view, of the same machine.

In a communication from the inventor, dated June 8, 1877, the following description is given: The machine is intended to be drawn by horses, the drawing representing one to be drawn by a team. "The frame is mounted upon two wheels. The front is a sheet-iron platform, over which revolves an elevator made of slats, which carry the locusts into boxes, where they pass between rollers, are crushed, and fall to the ground. The sides and top or back are wire screws, the whole forming

a scoop 16 feet long (on the bottom 19 feet), 8 feet high, the top of which can be lowered or raised according to the height of the grain or grass."

We annex a more detailed description:

AA, driving-wheels; B, guiding-wheel; D, setting-lever; *d*, retaining-post; G, endless carrier; H*h*, gearing for elevator and crushing-shaft; I, crushing-rollers; L, set-screw to spiral spring; *l*, spiral spring to press rollers together when necessary; N, slats on endless chain with sheet-iron projections to hold the locusts; M, drag-chain (or strips of light wood) to stir the locusts.

Mr. Peteler believes that, with a single-horse machine, 40 or 50 acres can be gone over in a single day, and by changing horses more can be done; but we, unfortunately, had no opportunity to test the practical working of the machine, as, by the time it was perfected, simpler and satisfactory methods were extensively being employed in Minnesota, and the inventor did not feel encouraged to manufacture his machine. Indeed, its expense is too great to warrant its manufacture, except to order by clubs of farmers. To use Mr. Peteler's own words: "This machine is intended for local or State authorities to use on uncultivated lands adjoining farms and unsettled prairies, in order to destroy the insects during the entire season; for that purpose there should be proper organization, with camp outfit, &c., to follow up the swarms, loading the machines on wagons, and battle with the 'hoppers morning and evening, when they are comparatively sluggish. These machines are not designed as temporary contrivances, believing that we shall have the scourge several seasons in some parts of the State, and they should be made strong and durable." Instead of paying bounties from the State treasury for the locusts, Mr. Peteler would have the State aid the farmers by investing in these machines. "Fifty thousand dollars advanced to farmers will place, at $40 each, 1,250 one-horse machines in their hands to keep their grain-fields clear. If they use them only 60 days during the season, and go over only 40 acres per day, destroying but one-half bushel per acre (frequently they would destroy 8 to 10 bushels per acre), they would send 25,000 bushels daily, or 1,500,000 in 60 days, where bad 'hoppers go. That money would be returned to the State in four to six months by the farmers, provided the State and local authorities will do their duty by destroying the pests on uncultivated lands."

Under this head we may mention the curious suction-fanning machine invented by Mr. J. A. King, of Boulder, Colo., and one of which, purchased by Mr. T. C. Henry, of Abilene, Kans., we had the opportunity to fully test. It consists of two large tin tubes (Pl. V, Fig. 2, AA), about 8 inches in diameter, with flattened, expanded, and lipped mouthpieces, B, running near the ground. This horizontal opening or mouth is about 7 feet long. The tubes connect at the upper extremity with a chamber, C, in which is a revolving fan which makes about 1,200 revolutions per minute. The tubes and fan, with the gearing, are placed in a frame, D, 5 by 10 feet, mounted upon two large driving-wheels, E E. Pl. VI represents this machine in operation.

The air-current made by the revolving fan creates a suction at the mouth, which draws the insects up the tubes and into the chamber. They are then thrown by the fan upon a wire screen, and from thence drop into a kind of hopper which conducts them to a bag. The wire screen rapidly chokes up and must be frequently cleaned. Most of the locusts are crushed and mangled by the rapidly revolving fan, so that the screen may be removed entirely and the locusts thrown out behind. This allows a freer draught and causes a greater suction. This machine

can be made for about $50, and it works well on smooth ground or in a wheat-field while the wheat is yet short. It is somewhat difficult to keep the lips close enough to the ground. The principle of the machine is a good one, and we see no reason why some cheaper modification of it should not be quite generally used early in the season, especially in Colorado, where there is so much hard, smooth ground around the cultivated fields. The lips might be protected and rendered less liable to bend and get out of order by moving on runners made to extend some distance in front.

Finally, a machine which we saw in Colorado, and which was put up by J. S. Flory, of Greeley, Colo., is worthy of mention in this connection; for, while it may be used with coal-tar, it is essentially a catching and crushing machine. The Colorado Sun thus speaks of it:

The main feature of this invention is a revolving platform of heavy canvas or wire cloth, which runs between two horizontal rollers. Long arms reach forward, which support a revolving reel; from these arms downward extend sheet-iron sides, over the top a canvas covering; all so constructed as to form a large wide mouth, into which the 'hoppers are driven by the arms of the revolving reel and carried between the two rollers and crushed. Horizontal strips running along the rollers serve to keep the rollers and platform clear of the crushed grasshoppers. The whole machine is supported on two main wheels about the middle, and two smaller ones in front. Extending back is a frame or cross-bar, to which one or two horses may be hitched to push the machine forward, or it may be operated by hand. The front of the platform runs close to the ground, and by bearing down at the rear by the driver, it can easily be lifted over any obstruction that may be in the way. The machine can be raised or lowered in front to suit the crop over which it is run.

This invention will destroy the grasshoppers without the necessity and expense of using oil or tar. The patent, we understand, also covers the combinations of a receptacle immediately under the rollers, into which the grasshoppers are carried, and into which, if need be, water and oil may be kept, and also a long narrow hopper (just over the rollers), into which coal-tar may be put and allowed to run through on to the platform, thus making it a *self-tarring machine*. Either of these combined methods of destroying the 'hoppers may be used as the farmer may choose. The machine is so simple in construction that any ordinary workman can put them up at a comparatively small price. The machine may be made of any size desired, from a small hand-machine to one a rod or more in width.

Pl. IX, Fig. 2, represents a front view of this machine when in operation, and Fig. 3 a side view of the frame, of which Messrs. Flory & Co., the manufacturers, send us the following description:

The rollers B and C¹ are 8 feet between the side-pieces. The roller B, forming the axle, is about 16 inches longer than the other. The wheels are 24 inches in diameter, 4 inches thick, made of pieces of 2-inch lumber. Front roller, C, 8 feet between side-pieces, 4 inches in diameter. Front wheels 10 inches in diameter, so set as to let the front roller and platform run within a few inches of the ground. Front wheels should be on movable axles, so as to raise or lower the machine. The platform is made of heavy ducking, endless, and revolves between the two rollers B and C¹. A head-block and key at each end is used to drive the roller C¹ up tight against the axle B. Side-pieces are made of scantling 2 by 6, 7 feet in front, 9 feet in rear of axle. Arms, G G, 2 by 2, so arranged as to raise or lower the cover P. Cross-piece in front of roller C (diagram 2), set so close as to serve as a cleaner to the platform, also protects the platform from rocks, &c. A short apron is attached to this piece, extending to the ground. (If necessary, a cleaner-strip may be placed immediately under roller C¹ (diagram 2).) W are canvas wings, extending forward and outward at an angle for the purpose of driving the grasshoppers in from either side; and as the machine advances, they jump on to the movable platform and are carried into the rollers B and C¹ (diagram 2) and crushed. X X are iron rods hanging by ropes from the end of front cross-piece T. V V are wires extending from end of iron rods to cross-piece T. To the iron rods and wire the canvas sides are sewed. An apron of canvas hangs from the iron rods X X to sweep the ground. Over the top to the pieces C C a canvas cover is placed, tacked on, extending back to the cross-piece F. The sides are also closed up with canvas.

3. TRAPPING.—This can be easily accomplished, especially when the locusts are making their way from roads and hedges. The use of nets or seines, or long strips of muslin, calico, or similar materials, converging

after the manner of quail-nets, has proved very satisfactory. By digging pits or holes three or four feet deep, and then staking the two wings so that they converge toward them, large numbers may be secured in this way after the dew is off the ground, or they may be headed off when marching in a given direction. Much good can be accomplished by changing the position of the trap while the locusts are yet small and congregate in isolated or particular patches.

Mr. A. N. Moyer, of Wyandotte, Kans., writes, March 22, 1877:

A street or an alley will cause the locusts to vary a few points from their line of march. So, when approaching the banks of a river before being able to fly, they will follow the banks seemingly in search of a bridge. At Independence, Mo., they came into town and were led to the public square, which is surrounded by a wall of dressed stone; several wagon-loads were removed in one day. Now, in aiming to capture and destroy them when they are on the march, suppose a portable fence lined with tin or some smooth material be used, and placed in the form of a V with an opening at the apex, and there a receptacle for them be placed or dug, I think immense quantities could be corraled in a day, with very little labor. I have worked on that plan somewhat, and know whereof I speak. Then, to assist them, let two men, holding opposite ends of a long piece of canvas, or any light material which will bear a long stretch, surround and steadily run them into the portable pits.

A second fact concerning their habits can be utilized. At night, if cool, or at the approach of a shower, they run for shelter; trees always preferred. If on every acre or every five acres a cistern could be dug and some branches placed high above it or a tree placed as if in the center, immense quantities could be caught. I have seen many bushels massed at the foot of a large elm, between the cavities formed by its great roots; they were a writhing mass a foot in depth.

Mr. F. M. Dougan, of Mount Pleasant, Kans., has met with considerable success with the following mode of ditching:

Dig a pit 3 feet deep and from 2 to 7 feet wide, then make a ditch 2 or 3 feet broad and about 2 feet deep, running from the pit toward the point from which the locusts are making their appearance. To gather a broad army of insects, take a plow and run furrows diagonally from the ditch, which must afterward have all loose earth removed with spades. In this way the insects are brought together toward the ditch and finally into the pit.

Ditching and *trenching* properly come under this head; and both plans are very effectual in protecting crops against the inroads of traveling schools of the insects. They were found especially advantageous in much of the ravaged country in 1875, where there was little or no hay or straw to burn. They are the best available means when the crops are advanced, and when most of the other destructive methods so advisable early in the season can no longer be effectually used. Simple ditches, two feet wide and two feet deep, with perpendicular sides, offer effectual barriers to the young insects. They must, however, be kept in order, so that the sides next the fields to be protected are not allowed to wash out or become too hard. They may be kept friable by a brush or rake.

"The young locusts tumble into such a ditch and accumulate and die at the bottom in large quantities. In a few days the stench becomes great, and necessitates the covering up of the mass. In order to keep the main ditch open, therefore, it is best to dig pits or deeper side ditches at short intervals, in which the locusts will accumulate and may be buried. If a trench is made around a field about hatching-time, but few locusts will get into that field until they acquire wings, and by that time the principal danger is over, and the insects are fast disappearing. If any should hatch within the inclosure, they are easily driven into the ditches dug in different parts of the field. The direction of the apprehended approach of the insects being known from their hatching locality, ditching one or two sides next to such locality is generally sufficient, and when farmers join they can construct a long ditch which will protect many

farms. * * * Where the soil is tenaceous and water can be let into the ditches so as to cover the bottom, they may be made shallower and still be effectual. The width and depth of the ditch is important, and as experience differed somewhat, I have been at pains to get the experience of a large number of correspondents addressd by circular. Many have successfully used ditches 2 feet deep and 18 inches wide; a few have made them only 18 inches by 18 inches. Those who have used water found 12 inches by 15 inches sufficient, while the larger number used a ditch such as I have recommended, viz., 2 feet deep by 2 feet wide, with perpendicular sides. Having been the first to recommend proper ditching in this country, I have felt particular interest in its results, and have been in no small degree amused at the fault found with my recommendation by those who, through slovenly-made ditches or other causes, have not been successful in this mode of warfare. It is less effectual against the newly-hatched young, which more easily crawl up a perpendicular bank than the larger ones, and its efficacy will vary with the nature of the soil and other circumstances; for, in proportion as the soil is loose, and the ditches hence apt to fill up by the action of strong winds, or in proportion as strong winds carry the insects over, ditching will necessarily fail."

"Those who, from theory rather than from experience, are skeptical about the efficacy of ditching, urge that the locust, especially in the pupa state, can hop more than two feet. In truth, however, whether when traveling in a given direction of their own accord, or when being driven or disturbed, they very seldom leap that distance, as all who have had experience well know. That, on a pinch, the pupa can leap even farther, is true; but the fact remains that in practice *Caloptenus spretus* seldom does. So the chinch-bug, though capable of flight, will yet tumble into a ditch by myriads rather than use its wings. Even the larger winged Acridia and Œdipodæ tumble into such a ditch, and seldom get out again. I would remark in this connection, also, that a ditch three feet wide, unless correspondingly deep, will be more apt to permit the insects to escape, when once in, than a narrower one. In hopping, the more perpendicular the direction the insects must take, the shorter will be the distance reached.

"The efficacy of the ditch depends not so much on the inability of the young locusts to jump or scale it, as on their tendency not to do so. In the bottom of the ditch they soon become demoralized, crippled, and enfeebled by constant effort, and the trampling and crowding upon one another."

From the numerous instances that have come to our knowledge, we give the following to illustrate the benefits derived from proper ditching: Just back of the fair-grounds at Kansas City, Mo., Mr. F. D. Adkins had about three acres in vegetables in 1875. The locusts hatched in large numbers all around the city, but were especially abundant in the immediate vicinity of this truck-garden, and seemed bent upon its destruction. Mr. Adkins, remembering his experience with the same plague in 1867, began active operations in ditching for their destruction in 1875; and though the country for miles around was laid waste, yet this little three-acre field was untouched—a perfect oasis in the desert, at once giving pleasure to the eye, and speaking eloquently of what may be accomplished by a little judgment and perseverance.

Of the experiences in 1877 as to the efficacy of ditches, the following are some of the more valuable:

Yours of June 27 was duly received, and, in answer, would say, that up to the present our "'hopper-ditches" have proved entirely successful, or, at least, to my full

satisfaction, to wit: We have probably not lost to exceed one acre out of seventy-five planted, including corn, wheat, rye, oats, and potatoes or vegetables, among which we had planted pease, beans, beets, lettuce, onions, squashes, melons, &c. Our 'hoppers have been gone now ten or more days, but we are in constant fear that they will drop down upon us every day, but if they do not we shall have a full crop, so far as 'hoppers are concerned.

Inclosed please find a rough pen-sketch of my farm and surrounding country, showing the water and 'hopper ditches, also the different crops on the place and those of my neighbors, L. J. Apply, A. J. Gillman, and W. D. Cole, who cut ditches around what little wheat they have left unharmed after they saw that my ditches were proving successful, and I am happy to state that they have likewise been as successful as myself, so far as they took advantage of the 'hoppers, but they did not commence until these had eaten in some distance from the edge of their grain; consequently they were compelled to cut through their grain to head them off.

I first had a ditch cut all around the outside of my place, commencing on the northwest corner and finishing on the southwest corner, at the slough; then I had ditches cut around the garden, truck-patch, and wheat, to protect those from the 'hoppers hatched on the farm. My ditches were from one and a half to two feet wide, and about as deep as wide, with perpendicular banks or sides, and two post-holes side by side across the bottom of the ditch (with seven-inch post-auger bits) two feet in depth, about once every rod, at first, and afterward, in places where large swarms or herds attacked us, as often, sometimes, as every four feet.

Up to the time of the development of the 'hoppers' wings a less number of pits or trap-holes will do, but after that time it is very necessary to have the sink-holes near together, as the 'hoppers will travel but a short distance in the bottom of the ditch before they will attempt to climb the sides unless precipitated into a pit-hole; consequently the sink-holes are the most important part of the warfare, the ditch acting as a kind of run-way to the trap or sink-holes. As to the cost of the ditch it must be borne in mind that our land is a light sandy loam, and consequently very easy digging, and I was fortunate in hiring most of my laborers rather cheaply, from 75 cents to $1 per day and board, and the hands cut from 15 to 20 rods per day each, making an average of 17½ rods per day; but I think they were extra good laborers.

After the ditch was complete, and with sink-holes about one to every rod, I employed a good, responsible laborer for a month to keep the ditch in order and bore new sink-holes as often as the others were filled with 'hoppers, always putting some earth in the holes containing the 'hoppers, covering them to prevent their escape and the disagreeable odor from decomposition. And let me here remark that, while this last laborer made an average of two hundred and thirty sink-holes per day, two feet deep, he was at times unable to furnish sink-holes as fast as they were filled with 'hoppers, so that every few days I was obliged to furnish an extra hand to assist in making sink-holes.

In regard to the number of bushels of 'hoppers caught, it is difficult to determine, as a part of the holes would be filled full, and others probably not more than three-fourths full. Each hole, if full, would contain at least half a bushel of 'hoppers, if alive, and I think more rather than less.

The hatching-grounds were all about us, the ground being literally filled with eggs almost everywhere around us, as well as on the farm, 20 acres of which was breaking. I am quite certain that all the 'hoppers hatched on my farm were in the ditch before they were two weeks old, respectively; and had all of my neighbors commenced ditching as thoroughly as we did and as early in the season (I commenced about the middle of April), I am quite sure we would have had a good crop all about the country and with not more than half the labor that it was to us after the ditch was dug; besides we would have had but very few, if any, 'hoppers to take wings and fly away.

I have demonstrated to my mind that a ditch cut around 160 acres of land before hatching time, supplied with only a limited number of sink-holes, will catch all the 'hoppers hatched on said land, besides many from the outside, before they are more than two weeks old, respectively. 'Hoppers are very uneasy when young, and almost constantly on the move when the weather is fair, and will, as a consequence, reach the ditch at some point soon after they are hatched out. We had but little or no trouble to take care of the 'hoppers until after they were more than half grown and had traveled two or three miles and had collected in large droves; then they came in such numbers that it was sometimes difficult to take care of them. But if my neighbors had provided ditches, but a small number of those would have ever reached us.

The number of rods of 'hopper-ditch cut on my farm is between 650 and 700 rods, at a cost not to exceed $1 per acre of the entire farm of 120 acres.

Through low, wet places, where ditches are impracticable, stock-boards can be set up edgewise and use common fence-boards for caps (thus: T), breaking the joints of the stock-boards with the center of the fence-boards, to prevent the stock-boards from falling over.

There were times after the weather became warm when, in passing along the ditch, it would remind one of a hive of honey-bees swarming, from the buzzing noise of the

"bluebottle" flies, busy among the dead and dying 'hoppers in the sink-holes, and sometimes the stench was so great from decomposing 'hoppers that it was sickening to pass along to the windward of the ditch.—[J. C. Curryer, Saint James, Minn., July 12, 1877.

But people are everywhere coming back to the realization of the fact that the ditch is the best thing of all. At Clearwater they began at least a week earlier than at Monticello, and all turned to ditching with a prospect of saving half a crop.—[Mr. Allen Whitman, June 16, 1877.

Ditching is the most effectual way of fighting the young, but is too expensive in a new country where many poor men have to fight single-handed.—[J. G. McGrue, Audubon, Becker County, Minn., November 5, 1877.

Farmers living at Brushy Bend dug a ditch over half a mile long, on the north side of a farm. At the bottom of the trench they made holes about five feet apart, making about four hundred and eighty holes in all. Each of these holes will hold about a bushel, and the 'hoppers traveling south from the sand-ridges will fill them quite full in one day. This would seem incredible, but nevertheless that one ditch is destroying about four hundred and eighty bushels of 'hoppers per day.—[Nebraska Eagle.

They can be fought, and fought successfully. Pan, with kerosene or coal-tar may be economically used. But ditching is the thing; yes, the very thing. This season, in this county, hundreds of bushels have been destroyed by this method; whole farms, reaching hundreds of acres, have been perfectly protected. One of our citizens has taken over one hundred bushels, and this at a time when the insects were not one-third grown.—[A. H. Gleason, Little Sioux, Iowa, June, 1877.

From what I have seen, I believe that on the smooth, open prairie, where ditching is properly done, it is one of the best means of protection against the young 'hoppers.—[J. I. Salter, Saint Cloud, Minn., June, 1877.

Ditching has been resorted to and proved satisfactory. Nature of soil, sandy loam; depth of ditch, eighteen inches; width of ditch, two feet.—[Thomas Nixon, Argyle, Sumner County, Kans., June 5, 1877.

Protection by barriers.—Where ditches are not easily made, and where lumber is plentiful, a board fence two feet high and with 3-inch batten nailed to top on side from which the locusts are coming, the edge of it smeared with coal-tar, will answer as an effectual barrier, and prove useful to protect fields or gardens.

Coal-oil.—The use of coal-oil and coal-tar may best be considered in this connection, as both substances are employed in various ways for trapping and destroying the insects. As we shall presently see, in considering the different available destructive agents, coal-oil is the very best and cheapest that can be used against the locusts. It may be used in any of its cruder forms, and various contrivances have been employed to facilitate its practical application. The main idea embodied in these contrivances is that of a shallow receptacle of any convenient size (varying from about 3 feet square to about 8 or 10 by 2 or 3 feet), provided with high back and sides, either mounted upon wheels or runners, or carried (by means of suitable handles or supporting-rods) by hand. If the "pan" is larger than, say, 3 feet square, it is provided with transverse partitions which serve to prevent any slopping of the contents (in case water and oil are used), when the device is subjected to any sudden irregular motion, such as tipping, or in case of a wheeled pan, when it passes over uneven ground. The wheeled pan is pushed like a wheelbarrow; the hand-worked pan is carried by long handles at its ends. On pushing or carrying, as the case may be, these pans, supplied with oil, over the infested fields, and manipulating the shafts or handles so as to elevate or depress the front edge of the pan as may be desired, the locusts are startled from their places and spring into the tar or oil, when they are either entangled by the tar and die slowly, or, coming in contact with the more active portion of the oil, expire almost immediately. In Colorado they use it to good advantage on the water in their irrigating-ditches, and it may be used anywhere in pans or in saturated cloths, stretched on frames, drawn over the field. The method of using it on the irrigating-ditches in Colorado is thus reported by Prof. R. L. Packard: "It consists essentially in pouring, or, better, dropping coal-tar or coal-

oil on the running water with which the irrigating ditches are supplied. The method of supplying these ditches with oil is very simple. It is only necessary to sprinkle a few drops of coal-tar on the stream, when the oils contained in the tar are diffused over the surface of the water, and coming in contact with the insects (no matter how many), cause their speedy death. The toxic power of coal-oil upon the insects is very remarkable; a single drop of it floating on the water is capable of causing the death of a large number of insects. A simple and ingenious mode of keeping up a constant supply of the tar to a ditch I saw exemplified upon the farm of Mr. Arnett. A three-quart can is perforated on the side close to the bottom, a chip loosely fitting the aperture is inserted therein, and the can is then immersed (by a weight if necessary) in the ditch. Three quarts or less of tar, trickling out drop by drop from this slight vent, are sufficient to keep a great length of ditch supplied with coal-oil for thirty-six hours. The precise extent of ditch which may thus be rendered toxic to the locusts cannot, of course, be exactly stated. It is in fact quite indefinite, for the reason that the quantity of oil necessary to kill one of the insects is almost infinitesimal, and for the further reason that a single drop of oil will cover quite a large surface when dropped on water, so that taking these two facts together, it is easy to see that a very small quantity of tar or oil will serve to guard by means of ditches a large tract of territory from the ravages of the young (unwinged) locusts."

The pans that were used in Kansas and Iowa, but principally in the former State, were of very simple construction and very effectual. We give the descriptions of them as they first appeared in Mr. Riley's *Locust Plague in the United States*:

"A good and cheap pan is made of ordinary sheet-iron, 8 feet long, 11 inches wide at the bottom, and turned up a foot high at the back and an inch high at the front. A runner at each end, extending some distance behind, and a cord attached to each front corner, complete the pan, at a cost of about $1.50. (Pl. VIII, Fig. 2.)

"We have known from seven to ten bushels of young locusts caught with one such pan in an afternoon. It is easily pulled by two boys, and by running several together in a row, one boy to each outer rope, and one to each contiguous pair, the best work is performed with the least labor. Longer pans, to be drawn by horses, should have transverse partitions (Pl. III, Fig. 8) to avoid spilling the liquid; also more runners. The oil may be used alone so as to just cover the bottom, or on the surface of water, and the insects strained through a wire ladle. When the insects are very small, one may economize in kerosene by lining the pan with saturated cloth; but this becomes less efficient afterward, and frames of cloth saturated with oil do not equal the pans. Where oil has been scarce, some persons have substituted concentrated lye, but when used strong enough to kill, it costs about as much as the oil. The oil-pans can be used only when the crops to be protected are small.

"Small pans for oil, attached to an obliquing pole or handle, do excellent service in gardens."

Mr. A. A. Price, of Rutland, Humboldt County, Iowa, sends the Commission the following description of a coal-oil pan to be drawn on runners, and which was used with much success in Northwestern Iowa (Pl. VIII, Fig. 1):

Take a common board from 12 to 16 feet in length for the foundation or bed-piece. Make a tin trough 4 inches deep, 6 inches wide, and as long as required. Divide the trough into partitions by means of strips of tin, so that each partition is a foot long, thus avoiding the spilling of oil. Back of this place a strip of tin 16 inches wide and

as long as the trough. The back must be firmly secured by braces running down to the front edge of the board. Under all this place three wooden runners 3 feet long and shod with iron for the trough to ride on. Fill the pan half full of water, and then add a small quantity of kerosene—sufficient to cover the water. A horse may be hitched to the machine by fastening a rope to the outside runners. * * * The lightness of the machine will allow its being used on any crops. * * * * *

A machine of this sort was patented by Mr. Lorenzo B. Canfield, of Syracuse, Nebr. (Patent No. 187,509, dated February 20, 1877). The following description and figures will serve to illustrate his pan more fully. Pl. VII, Fig. 1, represents a perspective view; Pl. VII, Fig. 2, a longitudinal sectional view on the line *x x* in the preceding:

Referring to the parts by letters, letters A represent the pans, made of zinc, tin, or any light suitable material, and of any suitable size and depth adapted to the method of propulsion. For carrying by hand I have found about 2 to 3 feet long, 2 feet wide, and 3 to 4 inches deep a very good size. The sides of the pans may all be perpendicular to the bottom, except the front side, which should be a little inclined, as shown at Figs. 1 and 3, to facilitate passing over grass, oats, wheat, and vegetation similar in size. The pans A are placed in a row, close to each other, and united by bottom straps, B, to which they are secured by rivets, *b*.

C is a truss, its ends secured to the extreme ends and bottom of the two outer pans A, and its central part secured upon the upper end of a king-post, *c*. D D are handles, one at each end of the series of pans. E is an upwardly extended back for the pans, and is formed by simply extending the backs of the pans themselves upward, or by attaching a light cloth back to standards *e*.

It will be evident that the series of pans may be extended to any desired length, or that a single pan may be used short enough to sustain it own weight, or made longer and braced, as described, and divided transversely by walls into compartments, which will prevent the oil running all to one end of the device when such end is lower than the other.

In operation the device is carried by the handles D, with the pans near to the ground, and as it is advanced the insects jump up and are received in the advancing pan, or, striking the back E, fall into the petroleum, of which there is one-half inch or more in depth in the pans, where they die, or, jumping therefrom, die on the ground.

This pan was sold in the West at an exorbitant price, $4 being charged for royalty. Wherever we had an opportunity we advised farmers not to use it, but to construct others such as we have already described, and every bit as good, at far less expense. The principle cannot be patented, for since 1875 similar coal-oil pans, virtual outgrowths of the canvas frames originally employed for the same purpose, have been "known and used" in Colorado. This fact is sufficient in law to defeat any patent right based upon any application for a patent subsequent to such knowledge and use.

The essential features in all the contrivances are, in fact, 1. A platform that runs on the ground, on runners or wheels; 2. A canopy at right angles with it; 3. A reservoir at the junction to contain the liquid.

Another pan, of which we give a sketch (Pl. VII, Fig. 3), was made by Mr. James Adams of Abilene, Kans. It is 10 feet long, 2 feet wide; back (*a*) 1 foot high; front (*b*) about 2 inches high at the inner edge; ends (*c*) 2 feet high. The front is made of a board 6 inches wide, leaning inward at an angle of about 45°. A cloth screen is placed on the back part, which prevents the reel from knocking the locusts back over the pan.

The whole is made of pine, and costs $8 or $10. The pan is painted within with asphaltum paint, which renders it impervious to water or oil. The pan rests in front upon runners, to which ropes are attached for drawing, and on wheels behind which carry belts to turn the reel. The reel revolves just in front of the pan, causing the locusts to hop, and then knocking them into the pan. A brush of cloth is sometimes fastened to one arm of the reel to brush into the pan any locusts that may be on the front piece. Several of these pans were used about Abilene, and did good work.

A contrivance shown in Pl. VIII, Fig. 3, constructed by President John A. Anderson for use on the Agricultural College farm at Manhattan, Kans. The following description is taken from the Industrialist:

Yesterday afternoon we had the following cheap machine built in a couple of hours, which thus far promises to do all the work of either of the oil-machines: Three pieces of fence-board, 4 feet long and three or four feet apart, serve as sled-runners. To the front ends is nailed a fence-board 15 or more feet long. To this, and over the runners, three pieces of slats, each 4 feet long, are attached by a leather hinge; and inch-and-a-half holes through the back end of these slats receive light standards, the lower ends of which are fastened to the back ends of the runners by a leather hinge. Peg-holes in the upper half of the standards enable you to place the slats at any desirable angle. On the back ends of these slats is nailed a strip 15 feet long, parallel with the fence-board and 3 feet from it; and to these is tacked coarse muslin 15 feet in length, which forms an apron or movable screen that can be set at any angle. To the front ends of the outside runners a long piece of fence-wire was attached, and a mule was hitched to the wire, much to the disgust of the mule. A boy can pull the light machine, but mules pull longer than boys do.

On trial it worked to a charm; and this morning the ground gone over shows several dead 'hoppers to the square foot, notwithstanding the fact that they had quickly jumped off the apron. It should be used against the wind, and promises to be very effective. Any man can make the above in two hours, and it is worth trying.

It was found to do very good service, killing the young locusts in considerable numbers. The oil did not evaporate so rapidly as was anticipated. One thorough saturation was sufficient for fifteen or twenty minutes, when a little more could be added. If the machine be hauled against the wind, nearly all the locusts which hop will touch the oiled canvas. They generally take several hops upon the canvas before leaving it, thus insuring a thorough saturation with the oil. After hopping from the apron they can take two or three hops upon the ground, then lose all power in their hind legs, stretching them straight out behind, and finally, in one or two minutes after being "oiled," they are dead.

The Weekly Rocky Mountain News of May 16, 1877, contained the following notice and description of another contrivance:

Mr. Ben Long brought into town yesterday about a half bushel of grasshoppers, weighing 35 pounds, caught in four hours, on half an acre of ground, two and a half miles northeast of Boulder, with his new machine. The machine is composed of two troughs, each 5 feet long, and joined V-shape, the angle being toward the body of the machine. It takes up about 7 feet in width. The troughs are 5 inches wide, an inch high, filled mostly with water and covered with kerosene. Behind the trough is a wire screen, set in such a shape that if the 'hoppers jump against it they must fall into the trough. It runs so close to the ground that few, if any, of the pests escape below it.

Mr. C. L. Watrous, of Des Moines, Iowa, suggests a contrivance of this sort, with the addition of a wing on either side of the trough, extending forward and outward, so as to catch more locusts that may be upon the ground. He further states that this is about the only means that was employed there for killing them.

Mr. G. V. Swearingen, of Sidney, Iowa, under date of June 14, 1877, states:

The cheapest, and to my mind the most successful, device or machine is muslin or ducking, 10 feet long, about 2½ feet wide, fastened to strips at each edge, stretched at ends and in center or more places with other strips; a piece, 18 inches wide at rear, supported by upright strips. Saturate with coal-oil, and have a boy at each end carrying it slowly over the ground.

The locusts, in hopping, light on the saturated surface, and are killed by the coal-oil, which appears to me to be the most destructive to them of anything yet tried.

Coal-tar.—This may be used with most of the contrivances just described for the use of kerosene, and while not equal to the simple kerosene-pan for speed in trapping and destroying, is yet very useful, especially in the neighborhood of gas-works where the coal-tar can be obtained at nominal cost. It also permits the use of the simplest kind of pan.

Enough tar is spread over whatever receptacle may be used to cover well the bottom, and when this becomes sufficiently matted with the young locusts so as no longer to destroy the new comers, another coating is added, and so on until it becomes necessary to remove the whole mass, when it is shoveled from the pan and burned; or, what is far preferable, wherever there are wet ditches it may be thrown into these, when the oil contained in it, spreading over the surface of the water, destroys such locusts as may jump into or be driven into such ditches. Where the tar is scarce, as a matter of economy it will pay to melt the accumulated mass in iron vessels. By skimming off the dead locusts that rise to the surface, and thinning the residuum with a little coal-oil, it may be used again.

The Hon. A. B. Robbins, State senator from Wilmar, Minn., deserves credit for having, by an opportune letter in the Saint Paul Pioneer Press and Tribune of May 17, successfully drawn the attention of the people of his State to the advantageous use of coal-tar. It had been applied in one way or another in previous years, not only in Kansas and Colorado, but even Minnesota.

The New Ulm (Minn.) Herald of May 28, 1875, had urged its use spread upon sheets of building-paper, and the same recommendation was referred to in full in a report to the geological and natural history survey of Minnesota for 1876. The Farmers' Union, of Minneapolis, under date of August 8, 1876, in a letter from Greeley, Colo., had described the use of the same material spread over stout canvas fastened to a frame, to be dragged over the ground. It was referred to in the following words in Mr. Riley's eighth annual report for 1875:

Mr. Rufus Clark, of Denver, uses a piece of oil-cloth 9 to 12 feet long and 6 feet wide. One side and each end are secured to light wooden strips by common carpet-tacks, and the corners strengthened by braces. The oil-cloth is smeared with coal-tar, purchased at the Denver gas-works for $7.50 per barrel, and the trap is dragged over the ground by two men, a cord about ten feet long being fastened to the front corners for that purpose. The entire expense of the trap is about $3.50, and as it is light and easily handled, will be found serviceable on small as well as large farms. Zinc, instead of oil-cloth, has also been used for the same purpose.

Finally, the same use of it in much the same words was recommended on page 51 of the Report of the Conference of Governors held in Omaha in the autumn of 1876, ten thousand copies of which report were published; while it was further recommended in our first Bulletin, distributed in April, 1877. It is somewhat surprising, therefore, that its use should have proved such a novelty, though the fact finds explanation, perhaps, in the simple form of pan recommended by Senator Robbins, and the commendable enterprise which Governor Pillsbury displayed in aiding the farmers to obtain material. The coal-tar plan, when so forcibly brought to notice, gained favor at once and soon created quite a furore. The following extracts will show what was thought of it, the extent to which it was used, and the effective manner in which Governor Pillsbury assisted the farmers of his State:

When, after a brief effort to exterminate the insects, there seemed to be a common inclination to abandon the struggle in despair, a contrivance of sheet-iron and coal-tar was resorted to, with such results as promised a successful issue of a vigorous warfare upon the pests. Concurrent reports of the successful working of this device continued to reach me from various portions of the afflicted region, and, after much inquiry and a personal inspection of its operation on the theater of the worst devastation, I deemed it possessed of so much efficiency as to warrant an effort to induce its comprehensive use. I thought this justified both by the practical results to be expected and by the moral effect of a vigorous struggle in self-defense. The emergency not admitting of time for definite arrangements respecting the costs involved, I telgraphed the several counties concerned, offering to furnish immediate supplies, upon an understanding of future reimbursement by them. This offer was promptly accepted, and all available supplies

for material having been secured at wholesale sources, a vigorous war of extermination was maintained simultaneously in twenty-nine counties of the State. In three or four of these, comprising the dense center of the destroying swarms, the expedient proved unavailing. In all the rest, and especially wherever protective ditches had been first constructed, a fair degree of success attended these efforts, a vast amount of grain and other products having been by this means unquestionably rescued from destruction. In the prosecution of this enterprise there were employed about 56,000 pounds of sheet-iron and 3,000 barrels of coal-tar, which required a total expenditure of about $10,350. Toward this I applied the unexpended half of the five thousand which the last legislature placed at my disposal for relief purposes, and obtained the remainder upon my personal credit. The counties have made reimbursements as promised to the amount of $3,200, leaving about $4,700 yet to be provided for. As commendable efforts of this character, which aim at self-protection, without hope of reward other than that dictated by enlightened policy, are especially deserving of encouragement, I recommend that the State assume the whole expense of the movement, refund the sums which have been paid, and release from their obligations the counties which are in arrears.—[From Governor Pillsbury's annual message for 1877.

Meeker County, Minnesota, summoned the county commissioners and determined to send for 250 barrels of coal-tar and 1,000 sheets of iron. Other counties took similar action, and for a time it was impossible to supply the material fast enough. When tar was wanting, kerosene, molasses, ashes or sand moistened with kerosene, ashes and water, soft soap, or flour and water were used; the latter, when well filled with young locusts, was fed to the hogs. Tar was shipped over the different lines free of freight charge, and the State provided a supply of 1,000 barrels to be distributed wherever it was needed.—[Mr. Whitman.

Saturday, May 19, our community was much excited over the working of "Robbins's 'hopperdozer," sent from Willmar, on trial, It has taken like wild-fire, and I venture to say that to-day (May 23) there are over 1,000 of these contrivances in operation, capturing from two to five bushels per day per pan. It consists of sheet-iron pan 7 to 9 feet long, back and sides turned up 6 inches, and front edge about three-fourths of an inch, drawn by rope attached to wire rings 1½ feet from either end; bottom and sides thickly smeared with coal-tar, costing 10 cents per gallon by barrel; pan drawn over the ground very slowly. The efficiency of this simple contrivance is wonderful. One gallon tar is good for a bushel of 'hoppers, when rightly used. Some use two pans, that behind taking what the front passes over. Danilson and Cedar Mills are about the same, if not worse, than this town. Everybody begins to realize the situation.—[J. M. Howard, Litchfield, Minn., May 23, 1877.

Testimony is pouring in from all sides as to the wonderful success of that cheap little contrivance of sheet-iron and coal-tar invented by Mr. Robbins in sweeping up and destroying the grasshoppers. The people of Meeker County are so delighted and encouraged by the success of the experiments which demonstrate the ease with which, by means of this economical instrument, they can conquer the grasshoppers, that the people of the whole county are organizing to sweep the county clear of the plague. They have appointed a committee to take immediate steps to place these machines or the sheet-iron and coal-tar of which they are constructed, within the reach of every farmer in the county, and the county authorities have taken the responsibility of devoting to that purpose a small sum of about $1,500 in the county treasury. So great a demand, however, had sprung up for these materials, in consequence of the demand for the Robbins's 'hopperdozer, that it was beginning to be difficult to procure them, and the committee therefore came down to Minneapolis and Saint Paul to enlist the efforts of the governor, and he was so well satisfied of the efficacy of the sheet-iron and tar contrivance that he at once proceeded to make arrangements to furnish at cost all the coal-tar and sheet-iron which may be needed, not only in Meeker County, but throughout the State. He telegraphed to Milwaukee and Chicago to secure all the coal-tar that can be had there, and if this supply is not sufficient, arrangements will be promptly made to secure it from other sources. Similar orders were telegraphed for an indefinite supply of sheet-iron, and these materials will now be furnished by the governor either at Minneapolis or Saint Paul at the rate of $3 per barrel for coal-tar and 4½ cents per pound for sheet-iron, and the railroads will carry it free to any point on their lines. About 250 barrels of coal-tar have been ordered for Meeker County alone, and some five tons of sheet-iron, and it is thought they will require perhaps twice this when they get the whole people to work. The success of the Robbins's 'hopperdozer has had a wonderful effect, the committee say, in lifting the cloud of despondency which had settled on the brows of the farmers. The discovery that by the expenditure of one or two dollars in smearing a piece or two of sheet-iron with some coal-tar, and dragging it over the ground, they can easily exterminate the enemy that had seemed so formidable, and that seven cents' worth of tar will swallow up a bushel of grasshoppers, has put them all in splendid spirits, and they are now going to work with a will, one and all, to clean out the pest.—[Saint Paul Pioneer Press and Tribune.

The simple pan so extensively employed, and which was known as the

Robbins 'hopperdozer,* is shown in the accompanying illustration (Pl. IX, fig. 1), the general plan being that of the ordinary road-scraper. Its simplicity and durability account for its general use. It was usually drawn by hand, though several pans were frequently bound together and drawn by horses; while, in some instances, certain improvements in the way of mounting on wheels, so as to permit its being pushed from behind, were also adopted. We saw some with a wire screen or cover hinged to the back, so that the insects might be secured when the pan was not in motion; but the cover seemed superfluous. We also saw lime and kerosene mixed so as to form a mortar substituted for the coal-tar.

Another device was used in Colorado last summer, but is more complicated. It consisted of a skeleton cylinder of wood frame-work covered with canvas, the interior of which was to be coated with coal tar. The ends were opened and fans were arranged there, so constructed as to throw the locust into the interior of the cylinder, where they would become entangled in the tar and be poisoned by it. The machine runs on wheels whose axle is the axis of the cylinder.

A correspondent of The Kansas Farmer, in the issue of June 6, 1877, describes the following contrivance:

> I yesterday put together a machine which I do not propose to patent. It is constructed as follows: I had riveted together two sheets of stove-pipe iron, each 2 by 7 feet, making a surface of 4 by 14 feet. I rolled up the back side about 18 inches high, and held it to its place by nailing to it rounded inch boards. I turned up the front a trifle, and nailed to it a narrow strip of siding to stiffen the machine under the bottom, well back, so that it will balance. I fixed a three-eighths round iron for an axle, and fastened it by driving a staple over it near the ends and into the boards, end pieces. The wheels should be 16 inches in diameter, made of inch boards, three thicknesses nailed together, so that the grain of the wood will cross. I push my machine with a handle made of half-inch iron, a piece 12 feet long, the ends flattened, and fastened to the end board with screws, the rod bent up and made the proper shape, so as to come about to the bottom of a man's vest when operating the "dozer." I cover the surface with tar (common), which will burn and is poison to the 'hopper. The machine tilts over the axle and can be made to scrape the ground or raised to pass over grain or obstructions. The "dozer" is a perfect success, gathers the 'hoppers almost as clean as a reaper will cut grain; none get away. One week's work and four gallons of pitch tar will clean the worst 'hoppered 160-acre farm in Minnesota. At one priming with tar yesterday my man caught in about an hour a half bushel, estimated to make ten bushels when grown.

4. CATCHING OR BAGGING.—"There are innumerable mechanical contrivances for this purpose. The cheapest and most satisfactory are those intended to bag the insects. A frame two feet high and of varying length, according as it is to be drawn by men or horses, with a bag of sheeting tapering behind and ending in a small bag or tube, say one foot in diameter and two or three feet long, with a fine wire door at the end to admit the light and permit the dumping of the insects, will do admirable work. The insects gravitate toward the wire screen, and when the secondary bag is full they may be emptied into a pit dug for the purpose. These bagging-machines will prove most serviceable when grain is too high for the kerosene pans, just described, and they will be rendered more effectual by having runners at distances of about every two feet, extending a foot or so in front of the mouth, so as to more thoroughly disturb the insects and prevent them from getting underneath; also by having wings of vertical teeth, so as to increase the scope with as little resistance to the wind as possible."

Two important facts should always be borne in mind in using these bagging-machines: 1st, that they should always be drawn, as far as pos-

* A word that came into very general use last year among farmers for coal-oil and coal-tar machines, and which doubtless takes its origin from doze, in reference to the toxic effect of the coal-tar on the locusts.

sible, against the wind, if this be stirring; 2d, that in proportion as the insects and the grain are advanced in growth, and the former become predisposed to roost, in that proportion the machines will prove more serviceable at night.

We constructed a machine last summer embodying the features already mentioned, and it answered the purpose very well indeed. We reproduce the following account from the Scientific American:

Professor Riley, of the Entomological Commission, perfected last summer a grasshopper machine, which seems to be just the thing. It is intended to do away with all extra material, like coal-oil, which in the long run is expensive, and to work at all seasons, whether the insects are just hatching or full grown. It is not patented, nor does the Professor intend to patent it, unless it should be found necessary to prevent others from doing so. It was worked at Manhattan, Kans., and gave great satisfaction, and was described in the Industrialist, the organ of the Kansas State Agricultural College, as follows: (See Pl. X, Fig. 1.)

"The mechanical department has constructed a new locust exterminator for Professor Riley. The machine operates upon the bagging principle. It is, briefly, a large canvas bag stretched upon a light but strong frame, and placed upon runners, which extend with curved tips a little in front of the mouth. The canvas is stretched upon the inside of the frame, thus making the bag smooth and even within. This bag has a mouth (A) ten feet long and two feet high, and converges backward to a small box or frame, one foot square, with a slide cut-off (D). This box forms the mouth to a secondary bag (B), two and a half feet long and one foot in diameter, which ends in a second frame having two short runners below it. There is a sliding door (E) of wire gauze in the end frame, and the secondary bag is strengthened by a couple of strips of leather connecting the two small frames. The machine is made to "take more land" by means of two right-angled triangular wings (C), about six feet long, that hinge to the upright ends of the large frame in such manner that the rectangle joins the upper corner of the frame. From the lower side of this wing are suspended a number of teeth, or beaters, which, swinging loosely, drive the locusts inward. The machine is handled by means of two ropes hitched to the outer runners or to the outer and lower side of the mouth of the frame.

"On smooth ground the machine can be easily hauled by two men, but where the grass is tall and thick it pulls harder. The locusts, on hopping into the machine, soon reach the small back portion, enter the small bag, and are attracted to the rear end by the light which enters by the gauze door. When a sufficient number are thus captured the machine is stopped, the cut-off is slid down in front of the secondary bag, a hole is dug behind the machine, the bag tipped into it, and the insects buried. A strip of leather closes the slit through which the cut-off slips, and the main bag is made of dark cloth, while the secondary bag is white, so as by contrast to attract more thoroughly the locusts.

"The advantages of this machine are that it requires no additional expense to run it, as for oil, tar, &c. It will catch the winged locust as well as the young, if operated on cool mornings and evenings, and is adapted to almost all conditions of growing grain. The machine can be made for about $10, and perhaps less."

In practice we found it best to draw the machine by hitching to the runners, and to brace the wings at desired angles, according to the strength of the wind, by means of two iron rods, as in the illustration.

A net which has done good service, made by Maj. J. G. Thompson, of Garden City, Minn., is as follows:

Two pieces of common batten about 16 feet long were used as frame-work for the mouth of the net, one for the bottom and one for the top. From the end of the bottom piece a wooden shoe of the same material ran back about 6 feet to steady the trap, and serve as a runner. To the rear end of this shoe a similar piece was fastened by a hinge, and ran forward and was fastened to the top piece of the frame, so that the mouth of the trap would open and shut like a jaw. To hold the mouth open, two short, upright posts were fastened to the top piece by a hinge, and rested upright upon the bed-piece. The net itself was made of cotton cloth for the bottom, and the top was made of mosquito-netting. The mouth of the net extended 16 feet from one side of the trap to the other, and the net ran back about 6 feet to a point with a hole at the end to let out the insects collected. A boy ten years old can draw one end of this net, and by the use of it Major Thompson saved one piece of wheat.

Mr. J. C. Elliot, of Sheldon, Iowa, thus describes a machine of his own devising that was much liked in his section:

Take a strip of fine lumber 1 inch thick, 2 inches wide, and ten or 12 feet long; about 18 inches from each end mortise in a strip about 2 feet long of the same material as

your main piece; run a strong wire from one end of the main piece over the ends of the two upright pieces and fasten to the opposite ends of the main strip, forming the frame-work to the mouth of your dozer. The wire should be permanently fastened to the top ends of the upright pieces to form a brace to keep them always in place. Place the long strip of lumber on the ground so that the standards stand perpendicular; take two widths of strong cotton cloth the length of your main strip, sew them together so you will have double width, tack one side of the cloth to the long wood strip; this forms the bottom. Take of mosquito-bar enough to form a top to the net, fastening one side to the wire running over the top of the standards; put in such gores of cotton cloth at the ends as you may need to form a complete sack of the cotton cloth and mosquito-bar. A good plan to facilitate taking out the 'hoppers after caught is to let the back part of the net run to a point in the center, and leave a small opening, which can be fastened with a string while at work, and unloosened to empty out the 'hoppers. The object of the mosquito-bar is to allow the wind to pass through and keep the 'hoppers in the net.

A very successful method of catching pupæ was used by Mr. Lowe and Mr. Hall, farmers, in McLeod County, Minn. It is simply equivalent to a wagon-body with one side removed, to be drawn over the grain after dark. The locusts roosting on the grain fall into it, simply lie there and become entangled in a mass, and may be easily shoveled into a hole. Mr. Hall thinks he caught 800 bushels in the latter part of June; Mr. Lowe, 400.

While in Iowa we inspected one of the following machines, which was not in working order, however, at the time, nor was it much used, even in the locality where invented. It is patented by Mr. George S. Wilson, of Malvern, and Mr. John Rhode, of Tabor, Iowa (patent No. 192,553, dated June 26, 1877), and is described below. (Pl. XI, Fig. 1.)

a a represents two driving-wheels, upon which the machine is propelled about by a person or persons pushing from behind on the handle *c*. The frame consists, preferably, at each end of the two curved timbers *d*, as shown, between which is clamped a curved sheet-metal plate, *e*, which forms the floor of the machine. Secured to the inside edge of the top timber, at each end, is a curved plate, *g*, which forms a flange along each end of the machine, in order to prevent the insects from being swept or jumping from the floor.

To the rear edge of the floor is secured a box or receptacle, *i*, as long as the floor is wide, into which the insects are swept whole by the reel *h*. The cover of this box does not quite reach to the forward edge, thus leaving the space 1, through which the insects fall into the box. The upper end of the lid is turned backward a considerable distance, so as to form the flange 2, thereby preventing the insects from being swept back past the floor and opening 1 upon the ground behind.

Extending across the front edge of the machine is a board or bar, *n*, sharp at its front edge, and the ends of which project beyond each side of the frame, and serve as a support for one of the three braces or standards 3, upon the tops of which the reel is journaled, and operated by the belt or chain 8 over the pulleys 9. The axles 5, upon which the wheels *a* are placed, have their inner ends made U-shaped, so as to straddle over the edges of the timbers *d*, to which they are secured by set-screws. By thus forming these spindles a heavy axle is dispensed with, and the wheels can be adjusted back and forth, so as to regulate the distance the edge of the floor shall travel from the ground.

The sweeps of the reel may consist either of plain strips of wood, or the strips may have sheets of rubber or any other suitable material clamped in between or secured to them, as shown.

Mr. Samuel Godard, of Marysville, Mo., invented a machine for catching locusts (patent No. 191,421, dated May 29, 1877), of which we give the accompanying illustrations.

Pl. XI, Fig. 3, is a plan view of the invention; Pl. XI, Fig. 4, is a vertical section of the same, and Pl. XI, Fig. 5, represents an end view of the revolving frame.

a represents a suitable rectangular frame, which is mounted upon the two wheels *c* and provided with the two handles *d*, so that the whole machine may be pushed before a man, like a wheelbarrow. Where the machine is too large to be pushed by a man, the shafts *e* may be fastened upon the top of the handles by means of bands or loops *g*, substantially as shown, or of any other form, and then a horse be used for moving the machine about over the ground.

Mounted upon the top of the frame are the two brace-standards *h*, and journaled upon these standards is the revolving wire-covered frame *i*, of the form shown, and which is made to revolve by a belt, *j*, that passes over the pulley *l* on the end of the shaft on which the frame revolves, and down around the pulley *n*, fastened to the axle of one of the driving-wheels. The frame *i* has two openings, *o*, one in each end, that extends the whole length of the frame; and inside of the frame, to each opening, there is a hinged door, *r*, which is held open by its crank while the machine is in operation, and then closed as soon as the 'hoppers are caught, so that they cannot escape. In one or both ends of the frame there are made openings or doors, through which the captured 'hoppers can be removed from the frame to de destroyed.

This machine is to be pushed over the ground, and, as the 'hoppers rise in swarms before its approach, the revolving frame, with its openings at each end, flies around and gathers them in. After they are once in they can never escape the way they got in.

A machine somewhat like the above was invented by Mr. Finley E. Benson, of Walnut, Iowa (patent No. 184,223, dated November 14, 1876). Pl. XI, Fig. 6, represents a plan view of the machine, and Pl. XI, Fig. 7, a vertical section of the same. The following is a more detailed description:

a represents a long, narrow box or cage, which may either run upon the runners *c* or small wheels, as preferred. A portion of the front of this box is removed, as shown, and the inclined side covered with a sheet of tin, or other suitable substance, *d*, upon which the insects light, and then slide down, through the slit *e*, into the box. In order to prevent them from hopping out again, a guard, *g*, is made to extend horizontally over this opening in the front of the box, toward the inclined surface *d*, leaving just enough space between them to let the insect in, but not out again. In the rear side of the box *a* is made a light or long opening, *h*, which is covered over with wire gauze, so as to light the interior of the box, and thus cause the insects to fly toward it, away from the slit. The top of the box is provided with a hinged cover, *i*, through which is made a similar light, *o*, for the same purpose, and so that hot water or steam can be forced into the box to kill all the insects caught.

The box is drawn or forced forward over the ground, and, as the insects light on the incline *d*, the motion of the machine shakes them down into the box through the slit *e*, where they are killed, and then emptied out through the cover.

The machine invented by Mr. Dexter H. Hutchins, of Algona, Iowa (patent No. 187,012, dated February 6, 1877), differs from all the others in having attached a contrivance for killing the insects by means of sulphur fumes. Pl. XII, Fig. 1, is a top view, and Pl. XII, Fig. 2, shows a sectional view. The following description and letters refer to the accompanying drawings:

The frame A has a wooden bottom, B, and is mounted upon wheels C C. A drawer, D, is made in the front of the frame A, and opens to the front between the flies E E, attached to the frame F so as to project at an angle of about forty-five degrees outwardly from the frame F. The flies E E consist of wire frames G G, covered with canvas H, and are secured to the front uprights of the frame F, which is also of wire. Draw-flies I I are hinged to the front standards of the frame F, and are connected with the frames G G by spiral springs J J, which hold them open.

The frame F has its top ends and rear side covered with wire gauze. A tongue, K, leads from the rear of the frame A, is supported at its rear end upon a caster-wheel, L, the shank of which penetrates the tongue K, and is provided with a foot-lever, M. A driver's seat, N, resting upon a spring, O, is secured to the tongue at its rear end, in a position to permit the driver to operate the foot-lever M. A cord, P, connects the draw-flies I I, and a cord, Q, attached to the cord P at its center, leads to a slot, R, in the tongue K, where it connects with two cords, S S'. The cords S S' are secured, one to each side of the frame T, in which the caster-wheel L has its bearings. Pins U U' are fixed in opposite sides of the wheel L near its periphery. Metallic slats V are pivoted longitudinally on the frame A, and are connected at one end by the rod W. A single-tree, X, is secured to the tongue K slightly in front of the foot-lever M. The horses are harnessed to the machine with their heads facing the frame A.

The operation of the invention is as follows:

The slats V are left partially open, and the machine driven over the infested field. The grasshoppers rise from the ground, and are drawn or driven into the frame F by the draw-flies I I, which are closed every revolution of the wheel L by the pins U or U' engaging with the cords S or S', as the case may be, both pins engaging when the wheel L is straight, but only one when it is turned to either side to guide the machine.

The pins U and U′ are beveled on their rear sides, and the cords S and S′ slip from said pins, when the pins are at the rear of the wheels and in line with the bearings of the same, and permit the draw-flies to open by the spiral springs J J.

The pins U U′ and cords S S′ may be dispensed with, if desired, and the cord Q may be extended to the driver's seat and there operated by hand.

When the space beneath the metal slats V in the frame A has been filled with the insects, the slats V should be closed, and the drawer D, previously supplied with sulphur, opened, the sulphur ignited, and the drawer closed. The fumes of the sulphur will destroy the grasshoppers, after which the machine may be cleaned and the operation repeated.

Another contrivance was invented by Mr. Benjamin Sylvester, of Saint Peter, Minn. (patent No. 188,760, dated March 27, 1877), of which drawings are herewith given. The description refers to corresponding parts, and illustrates the mechanism and operation. (Pl. XII, Fig. 3.)

A is a carrying-wheel, of which there are two, one being mounted upon each end of an axle, *a*. A frame-work consisting of two arms, B, connected by a girt *b*, and carrying a driver's seat, B′, extends rearward from the axle *a*. The arms B are of such length and are placed at such distance apart that a horse can work between them and can propel the machine over the ground, being attached to a whiffletree which is pivoted to the girt *b*. C is a guiding or steering wheel, the shank C^1 of which is pivoted or journaled in girt *b* and provided with a hand-lever, C^2, arranged within convenient reach of the driver while riding in seat B′. At each end of the axle *a* there is a depending hanger, D^1, to which there is pivoted, at *c*, a vibrating arm, D, these two arms D D being connected by horizontal girts *d* and d^1. Immediately above the arms D there are two stationary arms, D^2, also connected by a horizontal girt, d^2. The arms D^2, girt d^2, and the axle *a* form a rectangular frame, over which is stretched a cover, E, the space between the arms D D^2 at each end of the trap being filled with a suitable flexible material, E^1. To the lower arms D and girts *d* d^1 is also attached a flexible covering, which hangs down loosely in rear of girt d^1 between that girt and the axle *a*, forming a bag or pouch, as indicated at E^2. This last-described part of the trap, consisting of the arms D D^2, their connecting-girts, and the covering E E^1 E^2, I usually denominate the cage. A cord, F, is connected with girt *d* or d^1, and passes over or through standard *f* and rearward to within reach of the driver. A revolving brush, G, is mounted in supporting-bars I. (Shown in dotted lines.) A belt, H, passes around a grooved wheel, A′, on one of the carrying-wheels A, and a corresponding pulley, G′, on the shaft of the brush G, thus causing the brush to rotate rapidly as the device moves forward over the ground and sweeps the grasshoppers or other insects into the cage.

By means of the cord F the height of the front part or edge of the apron or of the girt *d* from the grass or the grain or the ground may be indicated, and by a sudden upward jerk upon this cord any accumulation of grasshoppers on the apron between girts *d* d^1 may be readily delivered into the pouch or bag E^2.

When the device is made of suitable size it may be propelled by hand instead of horse-power.

The "Hero 'Hopper-catcher" constructed by John Carlen, Bernadotte, Nicollet County, Minnesota, is a simple bag with fan attachment, working somewhat on the same principle as the above.

Most of these patent contrivances are open to the objection of extra cost and complication without extra efficiency, and the simpler devices will always retain their deservedly greater popularity.

Mr. J. S. Belt, of the firm of Perkins & Belt, Saint Paul, Minn., constructed a simple sheet-iron pan, intended to hold the locusts without the aid of coal-tar. The machine consists of a sheet-iron platform with a front sweep of 8 feet, the back of which is elevated 7 inches and the front $1\frac{3}{4}$ inches, in the shape of a runner. Over the platform is a contrivance that holds the locusts that hop upon the machine, and an effective cover prevents any from hopping over the grate. The implement is easily pulled by ropes, and, with a 3-foot wing on each side, it sweeps over 14 feet of field. Its capacity is three bushels, and it can be emptied in ten seconds.

The following letter from Mr. Pennock Pusey, private secretary to Governor Pillsbury, expresses the opinion of those fully competent to judge of its value:

"This will be handed you by Mr. J. E. Belt, who will exhibit a locust-machine, which strikes the governor and myself as the best thing yet invented. It is on the same simple principle as that of the sheet-iron and tar dozer, but dispenses wholly with the tar, and thus saves cost and delay. It was tested yesterday by Mr. Raney, of Le Sueur County, who is probably the best practical authority in the State, and he heartily indorses it, as you will see by his letter. The inventor proposes to rush the manufacture of them extensively, and, all things considered, it seems worthy of notice."

We requested Mr. Whitman, our special assistant in Minnesota, to see the pan tried; he did so, and found it to work well, though it accomplishes nothing more than the tar-pan, and, on account of being more expensive at first cost, was not so generally used. The pan has, we believe, been patented, and can be built for $6.

Under the present head may be mentioned the method that has been and may be in future adopted, under peculiar and favorable circumstances, of driving the insects into streams and catching them, as they float down, in sacks; and, finally, the use of hand-nets, such as entomologists ordinarily use in collecting and catching winged insects. This method is strongly advocated by Gerstäcker, Körte, and other European writers, and may be employed with advantage in a small way with us where special crops are to be cleared that would be injured by other methods. A simple net, such as that herewith illustrated (Pl. XII, Fig. 4), may be cheaply constructed by any tinsmith; the only material required being a piece of stout wire, a hollow tin tube in which to solder the two ends, and a piece of cotton or linen cloth, a wooden handle of any desired length being inserted in the non-soldered end of the tube.

USE OF DESTRUCTIVE AGENTS.

We have never had much faith in the application to the plant or the insect of any chemical mixture, fluid, or powder, as a means of destroying the locusts: 1st, because nothing will more quickly or surely kill them than coal-oil; 2d, because of the impracticability of using any such application on the extensive scale that would be necessary. Yet as several parties sent us their various ingredients, patented or otherwise, with strong faith that in such they had discovered a locust panacea, we endeavored to give some of the more reasonable of them fair trial.

This we did the more willingly that it is possible to save special plants by some such means where the owners of the plants set a sufficiently high value upon them to warrant an amount of labor and expense that they would not think of bestowing on the ordinary crops of the field and garden. We, therefore, engaged Prof. R. L. Packard, of the Patent Office, and formerly chemist in the Department of Agriculture, Washington, D. C., to go to Colorado last June, while the insects were about two-thirds grown, and test various compositions and chemicals that had either been recommended by correspondents or which we ourselves desired to have tried. Among them we will enumerate the following: The spraying of coal-oil variously diluted; the use of "Buhach" or Persian insect-powder (fresh powder, from plants raised in California, was sent us by G. N. Milco, of Stockton, Cal.); Veith's insect-fluid* (also sent by the manufacturers); sulpho-carbonates; bisulphide of carbon; hot alum water; naphthaline; quassia water in varying strength; strong

* This is manufactured in Philadelphia, and recommended for all sorts of insects, for many of which it could be of no possible use; and, like many other patent nostrums for all insect ills, it is very much of an imposition.

tobacco water; uric or hippuric acid; sulphuric acid diluted with fifty times its weight of water; a few teaspoonfuls of saltpeter in a bucketful of water; salt water; vinegar; copperas water; cresylic soap.

Owing to unfavorable weather while in Colorado, Professor Packard failed to carry out experiments as completely as was desired; but we quote the following portions of his report, and shall refer in other chapters to other observations he made for the Commission:

The instrument in general use for destroying locusts is the coal-oil or coal-tar "pan," as it is called, many modifications of which are made to suit individual preferences or special emergencies.

As to chemical experiments, those chemicals only could be tried which would affect the insects by direct application to them, since, as remarked in a former letter, at the time of my visit the locusts were all young, very sluggish, and were not feeding. Consequently, of the hundred or more insecticides which have been patented in this country, most of which are to be used in protecting fruit-trees and other plants from the ravages of feeding insects, few could be tried. Of those remaining, aside from this class, the experiments of Dumas, conducted in France with a view to discover some agent destructive to the *Phylloxera*, have shown that the majority of such agents as are fatal to that insect are also destructive to the vines or detrimental to the soil, and, consequently, indirectly injurious to the vines. It would be useless here to enumerate the large number of natural and chemical compounds which the distinguished French chemist experimented with. Their number exceeds a hundred, and includes a large majority of those substances generally recognized as poisons. The report is to be found in "Annales de Chimie et de Physique," 5e série, tome vii, 1876. The general conclusion reached is that for attacking the *Phylloxera* the sulpho-carbonates and coal-tar are the best means to be employed. In dealing with locusts, however, the problem is an entirely different one from that to be solved in regard to the *Phylloxera*. In one case we have an active insect, continually moving from place to place above ground, while in the other a comparatively stationary insect, living under ground and remaining so as long as its food lasts, is to be dealt with. In the latter case the point was to find poisons which, giving off vapors during a sufficient length of time and acting in a confined space, would destroy the subterranean pest. In the former, however, the object has been to find some chemical which, acting by immediate contact with the actively moving locust, would cause its death, or which, scattered on the plants which it affects, would enter its system and so act as a poison. As before remarked, only the former of these objects could be kept in view, owing to the activity of the insects. No experiments, therefore, having in view the protection of plants could be made.

The following trials were made:

Buhach, or Persian insect-powder.—Several locusts immersed in this for from three-quarters of an hour to an hour, after being liberated from the bottle (they were completely immersed in the powder), brushed off the powder and moved off, although feebly. When the powder is blown upon them, as prescribed, they quickly brush it off, and disappear unharmed.

Veith's insect-fluid.—This proved to be very effective, killing locusts and plants with great celerity. Analysis shows it to be made up of oil of turpentine and a tincture (probably) of camomile. The oil of turpentine may well account for its deadly effects.

Sulpho-carbonate of potassium.—This salt was prepared from impure bisulphide of carbon, obtained in Denver (and containing naphtha), and an alcoholic saturated solution of hydrate of potassa. When sufficiently dilute, so as not to be injurious to plants, I think it is equally harmless to the insects. A strong solution (nearly saturated) causes the locusts to fall over and apparently kills them, but in fifteen minutes they revive, and in half an hour are able to hop off. A solution of 1 to 10 or 15 has to be repeatedly applied to have any apparent effect, and, as far as I could observe, this effect soon disappeared. The strong solution is sure and speedy death to plants, and yet does not appear to kill the insects, so that with a dilute solution, one sufficiently so not to hurt plants, no good effect can be had.

Naphthaline.—The impure specimens I was able to obtain at the gas-works in Denver, which contain many impurities, do not warrant me in reporting upon the effect of naphthaline as such. The effects I observed were far less satisfactory than those I obtained with coal-tar. Naphthaline, like bisulphide of carbon, can only work when kept in contact with the insects for some time. It gives off its vapors slowly, and is not, therefore, capable of successful application where locusts are concerned. I have watched a locust for three-quarters of an hour moving about over the impure naphthaline left in the oil-barrel by pouring out the oil (oil from coal-tar), whereas a single drop of the crude oil itself causes almost immediate death.

The above and Paris green are the principal substances experimented with, others being counted out, either for the reason that they are applicable only to the protection of plants against feeding insects which did not appear during my stay in Colorado;

that their ineffectiveness is well known, or that chemical considerations (*e. g.* in the case of sulphuric acid) forbid their use, or demonstrate its impracticability.

In conclusion, I will say that I am a witness of the speedy action of coal-oil upon young locusts, an action which is certain and immediate. I have taken a straw, dipped in the crude oil distilled from coal-tar, shaken off the pendent drop, and touched the insects with the residue. Treated with this minute quantity they died in from eight to ten minutes. I have seen substantially the same effect with kerosene. As only a small quantity of oil need be employed it is perhaps unnecessary to point out the difference in price between kerosene and crude coal-tar oil, but the attention of farmers may usefully be drawn to the fact that such difference exists. They have, chemically speaking, certainly discovered the cheapest and most effective remedy against the ravages of the unwinged locusts. No known chemical is at once so deadly in its action and at the same time so cheap as "coal-oil." Its manipulation is simple and unattended with any danger which cannot be easily guarded against by a little care. This fact, together with its comparative cheapness and freedom from danger of adulteration, are the advantages it possesses which recommend its use as an active poison. This point is, I think, clearly settled.

The other questions of protection to plants, and of the chemical value of the immense quantities of locusts which annually die in the West, considered as fertilizers, as well as the further question (interesting in a scientific point of view) as to what is the chemical nature of those secretions of the mature locusts which are said to be deleterious to fowls and even to affect the human skin, must as yet remain unanswered.

The deadly effect on animal life of carbonic-acid gas is well known. In 1875 we used it from a Babcock extinguisher, and gave it a thorough trial under many different circumstances and conditions, but without any satisfactory results. It had very little effect upon them even when played upon them continuously and at a short distance. They often became numbed by the force of the liquid, but invariably rallied again.

Paris green.—This, though it kills those insects which partake of it, is yet no protection to plants, because those which go off to die after partaking are always followed by others which go through the same operation. A new mode of using it was earnestly advocated and strongly recommended by one of our correspondents in Texas, viz., by sprinkling it, mixed in the ordinary way with from 20 to 30 parts of flour, upon the ground. The locusts were found to be attracted by the whitish powder, and to gather about and feed upon it. We had it thoroughly tried with varying success, as the following experience indicates:

I have tried the experiment of Paris green and flour (1 part to 30), and do not find it a success. The young locusts did not seem *especially* attracted to it, *i. e.*, only from a distance of a few inches, and of those which went on to it but few died. Mr. Payne states the same thing. I urged him to send a full statement of his experiment to you, as I knew he would have an earlier and better opportunity to try it than I should.—[A. Whitman.

In experimenting with Paris green brought in contact with the insect, I captured several specimens and rubbed them in this compound, then set them at liberty and watched their movements for half an hour or more. In each case I saw the insect free itself by rubbing from the dry powder, and at the end of the time specified I saw no difference between insects so treated and their companions. I put one specimen, after thorough immersion and rubbing in Paris green, in a specimen-box, and opened the box two hours after. The insect was as lively as ever, and had freed itself, as far as I could see, from all traces of the chemical. Indeed, it is difficult, speaking from a chemical or physiological stand-point, to see why Paris green in dry powder should have any toxic effect when externally applied. Its poisonous effects are due to the copper and arsenic compound of which it consists, and which can only act as a poison when taken into the system in solution.

I made the following experiments with the same substance diffused in water: Insects were kept for some time (3 minutes) in water holding Paris green in suspension. On taking them out, they waited until they were dry, then brushed off the dry powder, and for half an hour (as long as I watched them) behaved in all respects like insects not experimented with. The reason, apparently, is that Paris green, being insoluble in water under these circumstances, behaves like the dry powder; *i. e.*, the water evaporates, leaving the dry powder, which the insects proceed to wipe off.—[R. L. Packard.

In accordance with your request, I experimented with the Paris-green mixture. Used it on an inclosed square rod of wheat; also a rod of grass. Inclosure surrounded with boards a foot wide. One-half of each of these was treated by mixing Paris green

with thirty-two times its weight of flour, and placing the mixture in cones upon the ground. Cones formed by taking the mixture between the thumb and two next fingers and compressing it, and placing the same upon the ground on about every 9 inches square. On the other half, the mixture was sprinkled upon the grass and wheat while it was damp with dew. The mixture was eaten by the 'hoppers; where it was placed in cones it was covered with the insects. Should say that in thirty-six hours one-half the quantity had disappeared, and in forty-eight hours there were dead 'hoppers on the ground, but not in any satisfactory quantity.—[S. B. Coe, Morristown, Minn.

I have experimented with the arseniate of copper, as you desired, but with no practical effect. I mixed with dry flour first, but could find no dead locusts. I then mixed into a stiff dough and worked it into crumbs or pellets, and placed on the ground, made white by the dry preparation; result, one dead sparrow and one cowbird, both great destroyers of the 'hoppers; but I could not find any dead 'hoppers; perhaps the birds ate them, but I am inclined to believe that their death came by eating the poisoned dough. I do not think the 'hoppers are attracted by white substances in any marked degree, for on spreading the brightest rye-straw alongside of old, rotten hay, that was very dark in color, I found them more numerous on the hay than on the straw. I have tried spreading newspapers and dark woolen rags side by side, and always find the majority of 'hoppers on the darker substance. This, I think, is on account of the warmth imparted being greater from the hay and rags than from the straw and paper. —[J. I. Salter, Saint Cloud, Minn.

One of our assistants in Kansas, Mr. G. Gaumer, found that, spread upon the ground, it attracted and destroyed a great many; but it is very clear that this mode of destroying the locust cannot compare with many of those we have already described. Its use against the young locusts is practically of little avail, because of the excessive numbers in which they generally occur, and because of the danger incident to the use of a poison on so loose and extensive a scale as would be necessary to make it effectual. Several other ingredients were strongly recommended by correspondents who, had they tried their own recommendations, would have discovered the uselessness of the same. One suggested alum-water; another, from Estillville, Va., expatiated on the merits of common salt, to be used with an ordinary drill; while still others found some protection from the copious use of ashes and of gypsum. Of all the different applications, however, intended to protect plants, we doubt whether anything is more effectual than the spraying of a mixture of kerosene and warm water, which will answer a very good purpose when the insects are not too numerous or ravenous.

THE PROTECTION OF FRUIT-TREES.

The best means of protecting fruit and shade trees deserves separate consideration. Where the trunks are smooth and perpendicular they may be protected by whitewashing. The lime crumbles under the feet of the insects as they attempt to climb, and prevents their getting up. By their persistent efforts, however, they gradually wear off the lime and reach a higher point each day, so that the whitewashing must be often repeated. Trees with short, rough trunks, or which lean, are not very well protected in this way. A strip of smooth, bright tin answers even better for the same purpose. A strip 3 or 4 inches wide brought around and tacked to a smooth tree will protect it, while on rougher trees a piece of old rope may first be tacked around the tree and the tin tacked to it, so as to leave a portion both above and below. Passages between the tin and rope or the rope and tree can then be blocked by filling the upper area between tin and tree with earth. The tin must be high enough from the ground to prevent the 'hoppers from jumping from the latter beyond it, and the trunk below the tin, where the insects collect, should be covered with some coal-tar or poisonous substances to prevent girdling. This is more especially necessary with small trees, and coal-tar will answer as such preventives.

One of the cheapest and simplest modes is to encircle the tree with cotton batting, in which the insects will entangle their feet and thus be more or less obstructed. Strips of paper covered with tar; stiff paper tied on so as to slope roof-fashion; strips of glazed wall-paper, and thick coatings of soft soap, have been used with varying success; but no estoppel equals the bright tin. The others require constant watching and removal, and in all cases coming under our observation some insects would get into the trees, so as to require the daily shaking of these morning and evening. This will sometimes have to be done, when the bulk of the insects have become fledged, even where tin is used, for a certain proportion of the insects will then fly into the trees. They do most damage during the night, and care should be had that the trees be unloaded of their voracious freight just before dark.

Mr. George Gibbs, of Holden, Mo., found that the whitewash was rendered still more effectual by adding one-half pint of turpentine to the pailful.

DESTRUCTION OF THE WINGED INSECTS.

"The complete destruction of the winged insects, when they swoop down upon a country in prodigious swarms, is impossible. Man is powerless before the mighty host. Special plants, or small tracts of vegetation may be saved by perseveringly driving the insects off, or keeping them off by means of smudges, as the locusts avoid smoke; or by rattling or tinkling noises constantly kept up. Long ropes perseveringly dragged over a grain-field have been used to good advantage."

Of the different contrivances already described for the destruction of the unfledged locusts, those intended for bagging and catching are the most effectual against the winged individuals, great numbers of which may be caught, especially at morn and eve, and late in the autumn. At such times many may also be crushed. These winged insects are more to be dreaded in the northern than in the southern portion of the locust area, for in this last the small grains are always harvested before the advent of the pests, and Indian corn is the staple that suffers. The experience of Minnesota and Dakota farmers teaches that the injury from the winged locusts is best avoided by growing such crops as will mature early. Reports were current last summer in Texas that farmers near Calvert had destroyed great quantities of the winged insects by fires lighted at night. We had on several occasions witnessed swarms of locusts driven before a prairie-fire, and our general experience of locust habits at night forbade belief in the reports, and we requested one of our correspondents to inquire into the matter, with the following result:

I took pains to trace up, while in Texas, the report that the *spretus* was attracted by a blaze. I found it, of course, baseless, though it had attained very respectable proportions.—[J. T. Moulton, jr.

Moderate success has been had with smudging as a means of warding off the winged swarms. The best method is to start a fire which burns with insufficient access of air, and which is made, if possible, of materials which, while burning, will give off, besides the dense smoke due to incomplete combustion, unoxidized products of distillation which in themselves are noxious (*e. g.*, buffalo-chips, straw, and coal-tar, &c.). The smoke and fumes from such a fire will prevent the locusts from alighting and swerve them from their course. Mr. S. T. Kelsey succeeded in saving many of his young forest-trees in Kansas, in 1874, by perseveringly smudging and smoking them. He gives his experience in the following words, in the Kansas Farmer, August 26, 1874:

At first we tried building fires on the ground, but it was not successful. The smoke would not go where we wanted it to. We then tried taking a bunch of hay,

and holding it between sticks, set fire to it, and then, passing through the field on the windward side, held it so that the smoke would strike the grasshoppers. We would soon have a cloud of 'hoppers on the wing, and, by following it up, would, in a short time, clear the field. We have thus far saved everything that was not destroyed when we commenced fighting them; and while I do not give this as an infallible remedy, not having tried it sufficiently, yet it does seem to me, from what I have seen of it, that one good active man who would attend right to it could protect a twenty-acre field or a large orchard. But to be successful one must attend strictly to business.

The great difficulty experienced in making the smudging successful is in the inconstancy of the winds, as a sudden change in wind direction may render much previous labor unavailing. Mr. W. D. Arnett, of Bear Creek, Colo., who has given a good deal of attention to the practical means to be employed against locusts, has endeavored to meet the difficulty by using a portable iron bucket as a fire receptacle. A large sheet-iron bucket is fitted with a perforated tube, arranged across its bottom, open at one end to admit air, and there provided with a valve to regulate the admission of air. A perforated cover, hinged to the bucket, and a handle to carry it by, complete the arrangement. Filled with some substance which burns imperfectly, such as buffalo-chips and a little coal-tar, and with the cover shut, an amount of air insufficient for complete combustion is admitted through the valved tube at the bottom, and the dense smoke comes out through the holes in the cover.

The burning of old bones has been tried, but found to be no more effective than other slow combustibles. The use of smoke will be effectual in proportion as farmers combine together and produce it simultaneously over extended areas.

THE EFFECT OF CONCUSSION.

Two modes of concussion have been proposed for the destruction of insects or their eggs; the first being terrestrial concussion, produced by means of exploding powder or other similar compounds in the ground; the second, by means of small fire-arms or cannon. No experiments have yet been made that give anything like satisfactory results. The vitality, whether of the locusts or their eggs, will hardly be affected by such means. We received a number of communications on the subject of concussion during the year, and will quote a few passages from the correspondence in illustration of the different views held. Mr. L. A. Hardee, of Honey Moon, Fla., who is most enthusiastic in urging this supposed means of destruction, writes: "I do not know how many miles of the eggs of the 'hoppers can be destroyed by concussion of the ground, but it would not surprise me to know, when the experiment is tried, that 25 miles square would be destroyed by one explosion. Now, if one hundred pounds of gunpowder was buried, say three or four feet under ground, and this be ignited after a heavy rain, the concussion of the ground will destroy our small enemies that burrow in the ground for miles." Mr. P. A. Smith, of Lincoln, Nebr., writes: "We know the firing of cannon over and the explosion of torpedoes in water will kill fish; that the explosion of shells in time of battle has often been known to paralyze and sometimes kill human beings." Mr. Robert W. Furnas, president of the Nebraska State Horticultural Society, writes that "burying powder below the surface for its combustion and destruction of insects is simply nonsense, and time and money wasted."

On the other hand, Mr. A. J. Bell, of Mexico, Mo., says that during his residence at Ashland, Ky., he had a small vegetable garden, and noticed that his potato sprouts were covered with potato-beetles and locusts.

"There happened to be a local option parade, and an old cannon was used in the vicinity of the garden, for firing salutes. Next morning he had occasion to visit the garden and found all the insects *dead*, both 'hoppers and potato-beetles."

While we have little faith in the efficacy of concussion as a means of destroying either locust-eggs or young locusts, we were nevertheless desirous of giving the matter trial, and commissioned Mr. Prosper A. Smith, of Lincoln, Nebr., to thoroughly experiment and report to us, requesting him to avail himself also of the assistance of Professor Aughey. It turned out that Professor Aughey had tested it with no satisfactory results in 1875, and after a few fruitless trials further experiments were abandoned as "too ridiculous," writes Professor Aughey, to warrant further outlay.

DIVERSIFIED AGRICULTURE.

In Chapter IV we have dwelt upon the advantages of diversified agriculture from the locust stand-point, and we desire here simply to lay stress on its importance, nay its necessity. "There is nothing surer than that the destitution in Western Missouri and Eastern Kansas, in 1874-'75, was fully as much owing to the previous ravages of the chinch-bug as to those of this locust. The Chinch-bug is an annual and increasing trouble; the locust only a periodical one. Now, the regions indicated are, agriculturally, the richest in those two States, and, for that matter, can scarcely be surpassed in the entire country. Consisting of high, rolling prairie, interspersed, as a rule, with an abundance of good timber, this area produces a very large amount of corn and stock. Of cultivated crops, corn is the staple, and, with a most generous soil, it has become the fashion to plant and cultivate little else, year after year, on the same ground. The corn-fields alternate more or less with pastures, and there is just enough small grain to breed and nourish the first brood of chinch-bugs which pass into the corn at harvest time and which scatter over the country, by breeding and harboring in the corn-fields. Not to mention the different means to be employed in counteracting the ravages of this insect, a diversified agriculture is undoubtedly one of the most effectual. It must necessarily follow that the more extensively any given crop is cultivated to the exclusion of other crops the more will the peculiar insects which depredate upon it become unduly and injuriously abundant. The Chinch-bug is confined in its depredations to the grasses and cereals. Alternate your timothy, wheat, barley, corn, &c., upon which it flourishes, with any of the numerous crops on which it cannot flourish, and you very materially affect its power for harm. A crop of corn or wheat grown on a piece of land entirely free from chinch-bugs will not suffer to the same extent as a crop grown on land where the insects have been breeding and harboring. This fact is becoming partially recognized, and already hemp, flax, and castor-beans are to some extent cultivated in the States mentioned. But there are many other valuable root and forage plants that may yet be introduced and grown as field crops."

Governor Pillsbury, of Minnesota, has a few pertinent remarks on this subject in his last annual message. He says:

> In my former messages I took occasion to urge upon farmers a greater diversification of their crops. The present tendency, I fear, is toward an aggravation rather than a correction of the evil referred to. Stimulated by recent heavy crops, land-hunters have a passion for immense tracts and great wheat-farms. While the cultivation of our idle lands is always desirable, this pursuit of a single branch of farming is to be lamented. And I fear that the expectations of great profits of many inexperienced persons who are drawn into the movement by excitement is doomed to disappoint-

ment. A wiser course is to look to many sources of profit rather than to one. There is no better country than ours for the raising of stock. Our wool, beef, butter, and cheese are unsurpassed. With the production of these, wheat-growing alternates admirably to the advantage of all the products. The continuous cultivation of a single crop must eventually exhaust the soil of the constituents for its profitable growth, while it is well known that the finest wheat-crops were raised the past year on worn-out and abandoned grain-fields, which had been resuscitated by a couple of years' rest in grass. It seems almost culpable to import corn, hogs, beans, and other products which can be grown here to perfection.

What Governor Pillsbury says of Minnesota is equally true of a very large proportion of the country subject to locust injury. The advantage of growing more stock is especially obvious in some sections, not only as a means of best utilizing the surplus corn, but to avoid sweeping disaster; for when the locusts are so thick as to entirely sweep off cultivated crops, the wild prairie-grass is seldom so badly affected that it will not support stock.

LEGISLATION.

"Too much stress cannot be laid on the advantage of co-operation and concert of action, and legislation both to induce and to oblige action is important. In every community there are those who persist in doing nothing to prevent locust injury. These indifferents frequently bring ruin not only upon themselves, but upon more persevering neighbors, and any law will prove beneficial that will oblige every able-bodied man to work one or more days, either in the fall in destroying the eggs, or in the spring in killing the young insects, whenever the township trustees, at the request of a given number of citizens of the township, may call them to such work under special provisions similar to those of existing road laws."

In reference to bounty laws, the experience of Minnesota, where they were in force in some counties in 1875, is valuable, and the State commissioners did not hesitate to recommend the system after the county trials, imperfect as they were, and commenced as they were, in most cases, too late in the season. It was clearly shown that in one township $30,000 worth of crops was saved by an expenditure of $6,000. Nicollet County paid $25,053 for 25,053 bushels of locusts, but the price paid by other counties was higher; in fact, much too high. In 1877, the bounty system was less effective, and, indeed, proved more or less a failure. "As a means of defense," writes Mr. Whitman, "it would have proved useless in some cases and needless in others; as a matter of relief or reimbursement for injury it would have gone in a large measure to help those who are already repaid by an abundant harvest."

Governor Pillsbury, in his annual message for 1877, speaks of the Minnesota bounty-law, published further on, in the following rather severe terms:

These acts were approved by me with much reluctance, and not until I had strenuously but unavailingly endeavored to influence a correction in the act first named of what I deemed ill-advised provisions of a serious character. Prior to any movement for the practical operation of these laws, I received numerous statements from authoritative sources in all quarters of the infested regions, remonstrating against the appointment of measurers, as contemplated, on the ground that owing to the incalculable numbers of the insects the provision requiring the counties to pay all bounties in excess of the proposed State appropriation of $100,000 would virtually bankrupt the afflicted counties. I therefore deemed it proper to defer action for further knowledge and consideration. Finding upon calculation that an equal distribution of the available fund would afford to each inhabitant of the infested localities an average of but forty cents, a sum too trifling in itself to induce additional efforts for the extermination of the pests, I became convinced that the enforcement of the bounty-law would entail upon counties already impoverished by insect ravages a burden of debt which would prove more disastrous than the scourge it was intended to avert. I,

therefore, against the wishes of a few localities, but in compliance with a vast preponderance of petitions from the people directly interested, declined to make the appointments requisite for the practical operation of the law. The decision was justified by the result, for, in the absence of that concerted defense against the insects by ditches and other protective means dictated by experience, all efforts induced by the proposed State and county expenditures combined, would certainly have been unavailing, especially where the destructive swarms were most dense and where protection was most needed from their ravages. The sum thus saved to the State remains intact, or rather the contemplated loan was not effected, the law in express terms specifying the exclusive object for which it was to be effected.

"A good law, once enacted and on the statute-book, may not be called into operation for many years, but would beyond all doubt serve an admirable purpose in the event of a locust invasion. The following are what we conceive should be the essential features of an efficient bounty-law: 1. *The bounty should be paid out of the State treasury; or it should be graded and borne equally, one-third by the local townships, one-third by the county, and one-third by the State.* 2. *The bounty should be immediately available to those earning it.* 3. *The act should, so far as possible, tend to the destruction of the eggs.* 4. *After the eggs, the destruction of the newly-hatched locusts should be encouraged by the act.* A bushel of the newly-hatched insects will contain thirty or more times as many individuals as will a bushel of the pupæ, and, moreover, their destruction prevents the subsequent injury. It would be folly to pay 60 cents a bushel for them later in the season when they are nearly full-grown and have done most of the harm they are capable of doing. The price, therefore, should vary with the season; and while, in latitude 39°, 75 cents or $1 should be offered in March, the price should diminish to 50 cents in April, 25 cents in May, and 10 cents in June. As the dates of hatching vary with the latitude, so the law should vary in the matter of dates, according to the requirements of each particular State. In addition to the foregoing requirements of such an act, every precaution should be taken to prevent fraud and dishonesty in obtaining the money."

The laws obliging proper labor will prove more beneficial to a community than the bounty-laws, and the labor is best performed, first in destroying the eggs in the fall, and next in destroying the young insects after the bulk of them have hatched out in the spring.

In the more thinly settled parts of the country laws may be more or less ineffectual, so far as the general destruction of the insects is concerned, though they will even there be one of the best means of relieving destitution; but in more thickly settled sections they will accomplish both results.

The following are the State laws respecting locusts that have been passed:

MISSOURI.

AN ACT to encourage the destruction of grasshoppers.

Be it enacted by the general assembly of the State of Missouri, as follows:

SECTION 1. Any person who shall gather, or cause to be gathered by any person in his employ, eggs of the Rocky Mountain locust or grasshopper, at any time after they are deposited in the earth in the autumn of any year, and before they are hatched the following spring, shall be entitled to a bounty of five dollars for each and every bushel of eggs thus gathered, or for any quantity less than one bushel, bounty at the same rate, to be paid, one-half by the State and one-half by the county in which they are gathered.

SEC. 2. Any person who shall gather, collect, and kill, or cause to be so collected and killed, young and unfledged grasshoppers in the month of March, shall be entitled to a bounty of one dollar for each bushel, and for the month of April fifty cents per bushel, and for the month of May, twenty-five cents per bushel, to be paid in the same manner as in the preceding section.

SEC. 3. Any person claiming bounty under this act shall produce the eggs and grasshoppers thus gathered or killed, as the case may be, before the clerk of the county

court in which such eggs or grasshoppers were gathered or killed, within ten days thereafter, whereupon said clerk shall administer to such person the following oath or affirmation: You do solemnly swear (or affirm, as the case may be,) that the eggs (or grasshoppers, as the case may be,) produced by you, were taken and gathered by you, or by person or persons in your employ, or under your control, and within this county and State.

SEC. 4. The clerk shall forthwith destroy said eggs by burning the same, and give to the person proving up the same, under his hand and seal, a certificate setting forth in a plain handwriting, without interlineation, the amount of eggs or grasshoppers produced and destroyed by him, and the name and residence of such person producing the same, which certificate shall be in the following form:

STATE OF MISSOURI, *County of* ———:

This is to certify that ———, in the county of ———, A. B. did this day prove before me that he had gathered, or caused to be gathered, ——— of eggs, ——— grasshoppers, and is entitled to the sum of ——— dollars and ——— cents.

Given under my hand and seal of my office, this ——— day of ———, A. D. 18—.

——— ———, A. B.,
Clerk County Court.

Which certificate shall be received and taken by the collector of revenue of the county in which the same was given, and such collector shall be allowed pay out of the county and State treasury, one-half from each.

SEC. 5. Such clerk shall keep a register of all such certificates given by him, in a book which he shall keep for that purpose, in which he shall note down every certificate granted by him, the number and amount, and to whom granted, and transmit a certified copy of such register, under the seal of the court, to the treasurer of the State, who shall not allow and pay any certificate which does not correspond with such register.

SEC. 6. Such clerk shall receive for his services as aforesaid one dollar for such certified copy of the register, and the regular fee for the certificate and seal, and ten cents for each certificate granted under this act, all to be paid out of the treasury of his county.

SEC. 7. As the object of this act is the rapid destruction of the locust the ensuing spring, it shall take effect and be in force from and after its passage.

Approved February 23, 1877.

This act is drawn up after the form recommended in Mr. Riley's eighth report, and reprinted in the Omaha pamphlet. Section 3, requiring persons claiming bounty to carry from all parts of the county the eggs or young insects collected is defective, as those living near the county seat will have most advantage and inducement. It would be better to empower the township trustee or the street commissioner to receive and measure the eggs or young insects, and to issue certificates setting forth the number of bushels destroyed, the certificates to be filed with the county clerk.

KANSAS.

AN ACT to provide for the destruction of grasshoppers, and to punish for violation of this act.

Be it enacted by the legislature of the State of Kansas:

SECTION 1. That the township trustees of the different townships, and the mayors of cities which are not included in any township of any county within this State, are hereby authorized, and it is made their duty when so requested in writing by fifteen of the legal voters of the township or city, to issue orders to the road-overseers of the different road-districts within their respective townships or cities, to warn out all able-bodied males between the ages of twelve and fifty years within their respective districts, for the purpose of destroying locusts or migratory insects.

SEC. 2. It shall be the duty of road-overseers, immediately after receiving said orders, to proceed at once to warn out all persons liable under section 1 of this act, giving notice of the time and place of meeting, and the tools to be used, and the kind of work expected to be performed, and all work shall be done and performed under the direction of the road-overseers.

SEC. 3. Any persons over eighteen years of age warned out as is provided in this act, may pay the road-overseer the sum of one dollar per day for the time so warned out, and in case any person shall fail to perform labor under this act or paying the sum of one dollar when so warned out, shall be adjudged guilty of a misdemeanor, and on conviction shall be fined the sum of three dollars for each day so failing or refusing, and the moneys so collected shall be expended by the road-overseers in the destruction of grasshoppers in their respective road-districts.

SEC. 4. For the purpose of carrying out the provisions of this act, the road-overseer is authorized to enter upon the premises of any person lying within the township where such order of the township trustee is in force, with a sufficient number of hands and teams to perform such labor as he may deem necessary for the public good.

SEC. 5. It shall be the duty of the secretary of the State Board of Agriculture, immediately after the passage of this act, to compile in circular form all information relating to the manner and means heretofore used for the extermination of grasshoppers, and send at least ten copies of the same to each township trustee in the State.

SEC. 6. This act shall take effect and be in force from and after its publication once in the Commonwealth.

Approved March 6, 1877.

AN ACT providing for a concert of action by senatorial districts for the destruction of grasshoppers.

Be it enacted by the legislature of the State of Kansas:

SECTION 1. That in any senatorial district in the State of Kansas where trouble is anticipated from the ravages of young grasshoppers in the year 1877, and any subsequent year thereafter, it shall be lawful for the counties in said senatorial district to co-operate together in the way and manner herein provided, for the destruction of the same.

SEC. 2. The chairman of the board of county commissioners in the county having the largest number of inhabitants in a senatorial district, where two or more counties form said district, may notify the chairman of each of the boards of county commissioners of the remaining counties in said district, of the time and place when the chairmen of the several boards of commissioners of the respective counties forming said senatorial district shall hold a joint meeting.

SEC. 3. At such meeting two of their number shall be chosen to act as chairman and secretary, and the proceedings of the meeting shall be published in all the newspapers printed in the senatorial district.

SEC. 4. Said meeting shall designate the manner of procedure by road-overseers, and what day or days the young grasshoppers should be driven from the cultivated land on the unburnt prairie or places of destruction, and shall also designate on what day or days the grasshoppers shall be destroyed, by burning or otherwise, in said senatorial district, giving at least ten days' notice of the same by publishing in the newspapers of the said district.

SEC. 5. The board of commissioners of each county shall notify the road-overseers of said county of the time fixed upon by the joint meeting for the driving and burning, or destroying by other means, of the grasshoppers in the district; said notice to be given to said overseers as soon as practicable after the same shall have been determined by the joint meeting.

SEC. 6. Said road-overseers shall immediately notify the residents of his road-district of the time designated and the manner of procedure, in order to carry out the provisions of this act. He shall also specify what tools or implements will be required of each resident in performing the labor required of him; and such notice may be enforced the same as in the acts authorizing road-overseers to warn out the residents to perform road-labor; and a refusal shall subject such persons refusing to the same penalties as are provided by law in such cases.

SEC. 7. The road-overseers shall direct the manner of performing the labor, and have the supervision of the same, and shall keep a list of the names of those who shall perform labor, and shall certify the number of days' work performed by each, and shall place such certified list in the possession of the board of county commissioners of his county.

SEC. 8. It shall be lawful for two or more senatorial districts to co-operate together under the provisions of this act, on a basis of action which they may agree upon.

SEC. 9. This act shall take effect and be in force from and after its publication in the Daily Commonwealth.

Approved March 7, 1877.

Both these acts look to compulsory work and concert of action, and in these respects are preferable to bounty acts, and will, without doubt, be productive of more good to the community and less expense to the State. The objects of the two acts were combined in one.

MINNESOTA.

AN ACT to provide for the destruction of grasshoppers and their eggs.

Be it enacted by the legislature of the State of Minnesota:

SECTION 1. There shall be paid by this State, out of any moneys in the treasury thereof not otherwise appropriated, to any person or persons living within any of the

counties in said State afflicted by grasshoppers, the following bounties for catching and destroying of the same, and the destruction of their eggs:

SEC. 2. The sum of one dollar per bushel for grasshoppers caught previous to the 25th day of May next; the sum of fifty cents per bushel from the said 25th day of May to the 10th day of June; the sum of twenty-five cents per bushel from the said 10th day of June to the 1st day of July, and twenty cents per bushel from the said 1st day of July to the 1st day of October next.

SEC. 3. There shall also be paid in the same manner the sum of fifty cents per gallon for any and all grasshopper eggs taken and destroyed by any person or persons.

SEC. 4. There shall be appointed by the governor a competent person in each township in the several counties so afflicted by grasshoppers, who shall be a resident of the township for which he shall be appointed, to receive, measure, and destroy the grasshoppers and their eggs delivered to him by any person or persons catching and taking the same, which said person so appointed shall take and subscribe an oath for the faithful discharge of his duties, which oath, together with the certificate of appointment, shall be filed in the office of the county auditor, and he shall receive as compensation for his services such sum as the county commissioner may determine, to be paid out of the funds of the county; and, in case of necessity, when he cannot perform the duties of his office, said measurer shall have authority and be empowered to appoint a suitable and competent person his assistant, which assistant shall be required to take and subscribe the same oath and be subject to the same penalties as the said measurer.

SEC. 5. The person receiving and measuring the grasshoppers and their eggs as aforesaid shall measure and immediately and effectually destroy the same, and keep an exact account of all the grasshoppers and their eggs received by him and the names of the persons delivering the same, and shall issne a certificate for the amount of grasshoppers and their eggs to the person delivering the same. And he shall, at the end of each week after commencing to receive and measure the same, and on the 2d day of June, on the 11th day of said month, on the 2d day of July, and on the 2d day of October next, make a report to the county auditor of all the grasshoppers and their eggs measured by him, the number of certificates issued, and the names of the persons to whom he issued the same; and the county auditor shall examine the same and file it in his office, which report shall be subject to public inspection; and the county auditor shall, at the end of each week after he shall have received the first of said reports, transmit a copy of the said reports to the governor, who shall, as soon as the sum hereby appropriated shall have been expended in the payment of said bounties, notify all persons interested therein of such fact by a publication of such notice in some newspaper printed and published at the city of Saint Paul, in said State of Minnesota, for three successive days.

SEC. 6. For a failure on the part of said measurer to perform any of his duties under this act, or for any mismeasurement of such grasshoppers and their eggs, he shall be deemed to be guilty of a misdemeanor, and be subject to pay a fine of not less than ten dollars nor more than one hundred dollars, or be imprisoned in the county jail for a term of not less than thirty nor more than ninety days, in a suit or proceeding to be prosecuted in the name of the State of Minnesota, in the same manner as is provided by law in other cases of misdemeanor.

SEC. 7. Upon the presentation of such certificate to the county auditor, he shall issue a certificate to the person entitled thereto for the amount due him (a form of which certificate shall be furnished by the State auditor), and shall make an order upon the State auditor for the amount thereof, and the State auditor shall draw his warrant upon the State treasurer for that amount in favor of the parties holding said certificates, which shall be paid by the State treasurer on presentation: *Provided*, That all certificates presented to the county auditor for payment shall be by him filed and preserved in his office, and he shall present such certificates to the board of county commissioners, who shall audit the same in the manner now provided by law for auditing accounts against counties; and no money shall be drawn from the State treasury until such certificates have been audited and allowed in the manner herein provided. And that no money shall be paid under the provisions of this act at any time prior to the fifteenth day of July, A. D. eighteen hundred and seventy-seven, and that the money hereby appropriated shall only apply to certificates duly made and filed with the auditor of state on or before said day; that at the time after the State auditor shall ascertain the total amount of all claims and certificates so filed, and if the same shall exceed in amount the sum of one hundred thousand dollars, then the said claims shall be paid *pro rata*, and no other or greater amount than said sum of one hundred thousand dollars shall ever be paid under the provisions of this act: *And provided further*, That if the amount hereby appropriated is not sufficient to pay the certificates in full, the balance shall be paid by the counties, respectively, according to the amount due on said certificates as issued by such county.

SEC. 8. Every male inhabitant of the several townships in the said afflicted counties, being above the age of twenty-one years and under the age of sixty years, excepting paupers, idiots, and lunatics, shall be assessed by the board of supervisors of said

township to work one day in each week in said township, during the period hereinbefore mentioned for the paying of bounties, for the purpose of catching and destroying grasshoppers and their eggs, for five weeks from the time said grasshoppers shall become large enough to be taken; and the amount of work to be so assessed shall not exceed five days in all.

SEC. 9. The supervisors aforesaid shall make a list of the names of all persons against whom said tax shall have been assessed, and place in a column opposite each name on said list the amount of labor assessed against such person, and shall direct the town clerk to make a certified copy of each list, after which the town clerk shall deliver the several copies to the respective overseers of the highways of said townships.

SEC. 10. The overseers of highways shall give at least two days' notice to all persons assessed to work as aforesaid, living within the limits of their respective districts, of the times and places where and when they are to appear for that purpose, and with what implements.

SEC. 11. Every person liable to work, as provided for in this act, may commute for the same at the rate of one dollar per day, in which case such commutation-money shall be paid to the chairman of the board of supervisors, to be applied and expended by him for the destruction of grasshoppers and their eggs, and he shall be authorized and required to hire and engage some suitable and efficient person to work in the place of said person so commuting, and to pay him the sum of one dollar per day for his services; and every person intending to commute for his assessment shall, within five days after he is notified to appear and work as aforesaid, pay the commutation-money for the work required of him by said notice; and the commutation shall not be considered as made until such money is paid.

SEC. 12. Every person so assessed and notified, who shall willfully neglect or refuse to commute or work as provided by this act, shall be guilty of a misdemeanor, and shall, on conviction thereof, be liable to pay a fine of not less than two dollars nor more than ten dollars, or by imprisonment in the county jail not more than ten days, or both, in the discretion of the court, in a suit to be prosecuted in the name of the State of Minnesota, in the same manner as is provided by law for prosecutions of misdemeanors.

SEC. 13. There shall be appropriated, out of any moneys in the treasury of this State not otherwise appropriated, for the purpose of carrying out the provisions of this act, the sum of one hundred thousand dollars.

SEC. 14. The board of county commissioners of any county in this State afflicted by grasshoppers shall have the right, if in their judgment they see fit, to employ one or more persons in each township in said county, with such implements or mechanical contrivances as may prove most efficient to destroy the grasshoppers, from the first day of April to the first day of August in each year, paying such persons either by the day or a specified sum for the amount captured and destroyed. The compensation of such person shall be paid out of the general fund of the county: *Provided further*, That parties employed and paid by the county commissioners shall not receive any other or further compensation under the provisions of this act.

SEC. 15. This act shall take effect and be in force from and after its passage.

Approved March 1, 1877.

This law, though doubtless framed with the endeavor to meet peculiar emergencies in Minnesota, always struck us as being much too complicated; and, in point of fact, as we have just seen, it was never enforced, and proved a failure.

NEBRASKA.

AN ACT to provide for the destruction of grasshoppers.

Whereas the State of Nebraska has, for the past three years, been devastated by the grasshoppers, thereby greatly injuring the agricultural and commercial interests of the State; and whereas these interests are liable to be seriously damaged in the future by the recurrence of the pests aforesaid: Therefore,

Be it enacted by the legislature of the State of Nebraska:

SECTION 1. That the supervisors of each road-district in this State shall, at the time when the grasshoppers shall have been hatched out, and before the same shall become full-fledged and fly, notify each able-bodied male resident of his district, between the ages of sixteen and sixty years, to perform two days' labor, at such time and at such place and in such manner as shall by said supervisors be deemed most efficient in the destruction of the grasshoppers; said notice shall be given in the same manner as is provided by law for the notice to work upon public highways.

SEC. 2. Cities of the first and second class shall be governed by the provisions of this act, and it shall be the duty of the mayor of such cities to appoint not exceeding two supervisors for each ward to oversee the labor to be performed under the provisions of this act.

SEC. 3. In case it shall appear that two days' work is not sufficient to destroy the grasshoppers in any district or ward, and it shall further appear that more time can be profitably employed in the destruction of the grasshoppers, the supervisors of each ward or road-district may require from the persons liable to the provisions of this act not exceeding ten days' labor in addition to the time hereinbefore mentioned; and it shall be the duty of such supervisor to give to each person who shall have performed labor under the provisions of this section a receipt for the number of days' labor performed, and the supervisor shall upon oath report to the city or county authorities the names and amount of labor performed by each person.

SEC. 4. It shall be the duty of all persons subject to the provisions of this act to attend when notified, as herein provided, and labor under the direction of the supervisor of their respective district or ward. Any person who, after being notified, shall refuse, neglect, or fail to comply with the provisions of this act, shall forfeit and pay to the county or city treasurers, as the case may be, the sum of ten dollars, together with cost of suit, which sum shall be collected by suit before any justice of the peace within the county, in an action to be brought in the name of the city or county.

SEC. 5. The supervisor shall report, under oath, to the city or county authorities, the names of all persons who shall have refused or failed to comply with the provisions of this act.

SEC. 6. This being a case of emergency, this act shall take effect and be in force from and after its passage.

SUGGESTIONS THAT MAY BE OF SERVICE.

In addition to the foregoing remedial and preventive measures to be taken in dealing with locusts, a few other suggestions occur which may be of advantage. The plants that can be grown which are generally unmolested by the pests, and which will not, in all likelihood, suffer, have already been enumerated. Those which are cultivated are principally pease and other leguminous species, castor-beans, sorghum, broom-corn, tomatoes, sweet-potatoes, &c. Such wild plants to which the insects are particularly partial, as tansy, wild buckwheat, &c., might be periodically sprinkled with Paris-green water or powder, so as to kill the young locusts that feed upon them. Such plants might also be sown and encouraged around cultivated fields where the young insects are expected to hatch out. These young will also congregate on timothy in preference to other grasses or grain, and a strip of timothy around a corn or wheat field, to be poisoned in the same way, might save the latter. It is also currently supposed that the common larkspur (*Delphinium*) is poisonous to these insects, but how much truth there is in the statement we are unable to tell. In going through an oat-field, the winged insects drop a great deal of the grain, which, when ripe enough, might at once be harrowed in, so as to furnish a good growth of fodder, that can be cut and cured for winter use. The lessons of 1873 and 1874 should also not go unheeded. The former year was one of plenty, and corn was so cheap and abundant that it was burned for fuel in many sections where in 1874 there were empty cribs, and the farmers wished they had been more provident.

Root crops of most kinds succeed admirably in the more northern portions of the locust country. Of the crops that would escape the ravages of the winged locusts, and which would grow in ordinary seasons and furnish excellent food for stock, may be mentioned turnips, rutabagas, mangel-wurzel, carrots (especially the large Belgian), parsnips, and beets. Of tubers that are not so profitable, but of which it would be well to plant small quantities in locust districts, for the reason that they grow with such ease and are less likely to be injured by the insects, the Chinese yam, Jerusalem artichoke (*Helianthus tuberosus*), and the chufa (*Cyperus esculentus*) are worthy of trial. Turnips, of which the insects are especially fond, kohlrabi, carrots, and the like, may be saved, when they come late, by cutting off the tops and covering the roots with earth, the

tops making excellent food for milch-cows. The earth should be removed again as soon as possible to prevent the rotting of the roots.

The benefits of irrigation, and the importance to the West of perfecting and enlarging the systems of irrigation now in vogue, we have briefly mentioned. With water at command, the farmer in all this locust area is measurably master of his two greatest insect plagues, the chinch bug and this locust, and full master of the young locusts, either by inundating the land and drowning them out after hatching, or by using kerosene in the ditches; and if there were no other reasons to be urged in its favor, these are sufficient to warrant those States included in said area in using all means in their power in having schemes for irrigation perfected and carried out, so far as the topography, soil, and other peculiarities of the country will admit.

Hogs and poultry of every description delight to feed on the young locusts, and will flourish where these abound when nothing else does. It will be well, in the event of a future invasion, for the people in the invaded districts to provide themselves with as large a quantity as possible of this stock. It may occur that where no systematic efforts have been made to destroy the eggs or the young locusts, these will abound in such threatening numbers as spring advances that there is little prospect of saving the crops on individual farms amid the general negligence. Under such circumstances, unless one is prepared to vigorously carry out the means of destruction we have advised, it may be well to delay the planting of everything that cannot be protected by ditching until the very last moment, or till toward the end of June—using team and time solely in the preparation of his land. In this way not only will he save his seed and the labor of planting, and, perhaps, replanting, but he will materially assist in weakening the devouring armies. Where proper and systematic efforts had not been made in time, men planted in 1875 and worked with a will and energy born of necessity, only to see their crops finally taken, their seed gone, and their teams and themselves worn out. "The locusts ultimately destroyed every green thing, until, finding nothing more, they began to fall upon each other and to perish. This critical period in their history would have been brought about much earlier if they had not had the cultivated crops to feed upon; and if, by concert of action, this system of non-planting could at first have been adopted over large areas, the insects would have been much sooner starved out and obliged to congregate in the pastures, prairies, and timber. Moreover, the time required for early planting and cultivation, if devoted to destroying the insects after the bulk of them hatch out, toward the end of April, would virtually annihilate them. The multiplication of any species of animal beyond the power of the country to support it inevitably proves the destruction of that species, unless it is able to migrate. Let fifty batches of canker-worm eggs hatch out on a single somewhat isolated apple-tree, and not one worm will survive long enough to mature. The leaves of the tree will be devoured before the worms are half-grown, and the latter must then inevitably perish; whereas, if only a dozen batches of eggs had hatched on that tree, the worms might all have lived and matured. In the same way, the young locusts inevitably perish whenever they are so numerous as to devour every green thing before they become fledged; and, in certain circumstances, the sooner such a condition of things is brought about the better. The greatest generals and the mightiest armies must yield to starvation.

"Grain might also be sown in 'lands' or strips, fifty to one hundred feet wide, to permit of ditching between them, and those who have fall wheat up and doing well, where the eggs are thickly laid, should make

ditches at intervals through the field to facilitate the saving of the grain in the spring."

In the cultivation of corn, or any crop that needs cultivation while growing, it is very desirable to keep the surface of the ground well stirred and pulverized by harrow or plow. The young insects dislike a pulverized surface, while the mature females also dislike it for oviposition.

"As a means of assisting farmers in the destruction of the unfledged locusts by trenches and in other ways, I would also urge the employment of the soldiers, a large force of whom, in times of peace, could be ordered to the field at short notice. To many, the idea of employing soldiers to assist the agriculturist in battling with this pest may seem farcical enough, but though the men might not find glory in the fight, the war, unlike most other wars, would be fraught only with good consequences to mankind. In Algeria the custom prevails of sending the soldiers against these insects. While in the south of France last summer [1875], I found to my great satisfaction that at Arles, Bouche du Rhône, where the unfledged locusts (*Caloptenus italicus*, a species closely allied to our Rocky Mountain Locust) were doing great harm, the soldiers had been sent in force to do battle with them, and were then and there waging a vigorous war against the tiny foe. A few regiments, armed with no more deadly weapons than the common spade, sent out to sections of country that are suffering from locust ravages, might in a few weeks measurably rout the pygmean army, and materially assist the farmer in his ditching operations.

"As to the best means of disposing of the slaughtered locusts, the easiest and most generally employed are burning and burying. Yet the insects might be turned to good advantage as manure, or sun-dried and preserved in cakes to feed to hogs, poultry, &c.; and where a large quantity are destroyed under a bounty system, some such means of making the most of them should be considered."

PREVENTIVE MEASURES AGAINST THE WINGED INSECTS.

The remedies and means so far recommended in this chapter look to the destruction of the insects when once they have fallen upon the more fertile country, or are hatching or likely to hatch therein. We hope we have shown that it is quite possible to cope with the young insects under almost any circumstances, and that this part of the locust problem may be considered solved. It was to this part of the problem, also, that the labors of the Commission were more particularly devoted during the last year, because the season was most opportune for that purpose; and we have already pointed out in the introduction that our labors in this line prevented a complete and exhaustive study of the other part of the problem, viz., how best to prevent the winged insects from overrunning the more fertile country or the Temporary region in which the species is not indigenous. It is to this part of the problem that the Commission intends to direct its efforts in future, with every hope of success, and it is for the purpose of rendering the investigation as complete as possible that we have appealed to Congress for the means.

The coming season will be as favorable for the solution of this second part of the inquiry as the past was for that of the first part; since there is no further need of spending time in the Temporary region, and we shall find a normal state of things in the Permanent region. Not until we have devoted another season (and perhaps several will be required) to the work, shall we be able to satisfactorily answer the great question

that is so frequently asked: "Cannot something be done to protect the farmer from the flying swarms?" in other words, "to prevent the migrations of the winged insects from their permanent breeding-grounds, to which, in ordinary seasons, they are confined?"

For the present we must content ourselves with pointing out the possibilities in the case, so far as our last year's experience has thrown light on the subject. Of the different means that have been suggested by which to avoid the incursions of the winged hordes from the Northwest the following may be mentioned: 1. The protection and encouragement to the increase of the native locust-feeding birds. 2. The introduction of foreign locust-feeding birds. 3. Inducements offered to the Indians to collect and destroy the eggs and young. 4. Destroying the eggs or young by making the greatest possible use by artificial means of the natural water-supply. 5. Burning the young in spring. 6. Diverting winged swarms by means of smoke.

While every one of these suggestions might be carried out in exceptional cases to advantage, and it is the intention of the Commission to endeavor to acclimate certain foreign locust-feeding birds; yet the last two methods are the only ones which at present we have any faith in as capable of sufficiently general application or as resulting in general good. The first question to consider is whether the insects can be prevented from migrating from their permanent breeding-grounds, and—considering excessive multiplication the immediate cause of migration—this virtually means whether they can be prevented from becoming excessively multiplied in such breeding-grounds. At first view it would seem hopeless to attempt anything of the sort, and a year ago we had such a vague and imperfect knowledge of these permanent breeding-grounds that any proposition looking to wholesale destruction of the insects in them would have appeared Utopian. But we have learned enough of the laws governing the movements of the species and of the country designated as the Permanent region to give us faith, not only in the possibility of thus keeping the species in check east of the Rocky Mountains, but in its feasibility.

There is a popular notion that this pest breeds in and comes from sandy, desert countries. It is a popular error. The insect cannot live on sand, nor does it willingly oviposit in a loose, sandy soil. It does not thrive on cacti and sage-bush. It flourishes most on land clothed with grass, in which, when young, it can huddle and shelter. It can multiply prodigiously on those plains only that offer a tolerably rich vegetation—not rank and humid, as in much of the prairie of Illinois, Missouri, &c., but short and dry—such as is found over much of the prairies and plains of the Northwest. Now, the destruction of the eggs, which is so practicable and effectual in settled and cultivated sections, is out of the question in those vast unsettled prairies; but the destruction of the young locusts is possible. Those immense prairies are not only susceptible of easy burning, but it is difficult to prevent the fire from sweeping over them. Some system of preventing the extensive prairie-fires in autumn that are common in that country, and then subsequently firing the prairie in the spring, after the bulk of the young hatch, and before the new grass gets too rank, would be of untold value if it could be adopted. The more we study the question, and the more we learn of those breeding-grounds, the more feasible the plan grows in our minds. The Dominion Government has, fortunately, a well-organized mounted-police force, which constantly patrols through the very regions where the insects breed north of our line. This force is intended to see that the peace is kept, to watch the Indians, to en-

force the laws, and perform other police duties. It could be utilized, without impairing its efficiency as a police force, in the work we have indicated, or it might be augmented for that same work. We have conversed with the ministers of agriculture and of the interior, and with Governor Morris, on the subject, and they see nothing impracticable in the plan. Indeed, it was suggested by Mr. Dawson in his first report on the subject of locust ravages in British America, and by Mr. Riley in his eighth Missouri report, for 1875 (p. 132). We have, on this side of the boundary line, a number of signal stations and military posts in the country where the insect breeds. We would have our own military force co-operate with the Dominion police force as a locust vigilance committee. Under the intelligent guidance and direction of some special commissioner or commission, we would have that whole country systematically studied every year by such a force with reference to the abundance or scarcity of the locusts. We would have such a vigilance force, by a proper system of fire-guards and surveillance, prevent the fall fires in sections where the insects or their eggs were known to abound, in order to burn them at the proper time the following spring.

This would be a stupendous work, and perhaps too expensive ever to be carried out, did the insects breed over the whole of the region we have designated as the Permanent region; but, fortunately, the breeding-grounds are in limited areas in this region, comprising the richer valleys and plateaux and strips along water-courses. It is for the Commission to accurately map out in detail these areas, and to estimate with what force and at what expense to the two governments the work can be performed. We have no hope nor idea that the pest can ever by human means be exterminated from that vast region, but do believe that it may be so kept in check that it will not migrate. The constant expense will be limited to the employment of the necessary force, and only at intervals when danger threatens will it be necessary to go to the extra and exceptional expense of destroying the insects. Again, there is a connection between locust-increase and seasons of drought, and we may take advantage of this knowledge by making especial effort whenever the character of the seasons indicates danger.

The next question to consider is, whether the farmer can be protected from the invading swarms, in case the above-mentioned plans should fail and the insects had become numerous. We think that this is also, to a large extent, possible with the proper system and organization. We would, in such an event, have this same corps of observers watch carefully the development and movements of the locusts and forewarn the farmers of the country of threatened danger. There is no reason why the agricultural community should not be informed the previous autumn as to the extent to which eggs have been laid, and as to the particular locations where laid; or why the following spring they should not be informed of the prospects, so as to plant accordingly, *i. e.*, put in a larger area of small grain that will be harvested before the winged swarms appear, and plant such crops as are best protected. Then, as the insects were commencing to migrate, their movements should be communicated to the people through the Signal Bureau. The information should be as minute, complete, and prompt as possible. These movements may be likened to those of a storm, and the people should receive in advance the danger signal, that they might guard against calamity. The "locust probabilities" are of far more importance than the weather probabilities to the people of the West, and the idea of having them telegraphed over the country does not appear half as chimerical to us now, as that of having the weather foreshadowed a few years ago.

In this way the farmers could be fully forewarned of approaching danger. We would, in this connection, have the Western farmers adopt some general plan of defense against possible invasion. The straw that is now allowed to rot in unsightly masses as it comes from the thrasher, and which encumbers the ground unless burned, should be utilized. Let it be stacked in small pyramids at every field-corner, and there let it remain until the locusts are descending upon the country. Then let the farmers in a township or a county or in larger areas simultaneously fire these pyramids, using whatever else is at hand to slacken combustion and increase the smoke, and the combined fumigation would partially or entirely drive the insects away, according as the swarm was extended or not.

In short, we believe, first, that by proper co-operation on the part of the two governments interested, the excessive multiplication of this destructive insect may be measurably prevented in its natural breeding-grounds, and that the few thousand dollars that would be necessary to put into operation intelligent co-operative plans are most trifling in view of the vast interests at stake. With an efficient and properly organized Department of Agriculture, liberally supported by Congress; with the aid of the War Department, the Signal Bureau, the Post-Office Department, and the Indian Bureau, the plan could be perfected and carried out at minimum expense. There is no reason why every signal officer, every postmaster, every mail-carrier, every Indian agent, and every other government employé in the Permanent region should not be ordered to do service of this kind, and made, under the direction of an intelligent head, a medium through which to gather the desired information. We believe, secondly, that where the multiplication of the insect cannot be prevented in its natural breeding-grounds, our farmers in the more thickly-settled sections may, by the use of smoke, measurably turn the course of the invading swarms and protect their crops—obliging the insects to resort to uncultivated areas.

Did the injury continue for another three or four years as it has for the past four; were the Western farmers to suffer a few more annual losses of $40,000,000, such schemes as we have suggested would soon be carried out. The danger is that during periods of immunity, indifference and forgetfulness intervene until another sweeping disaster takes us by surprise. The other danger is that the majority of our Congressmen and Senators at Washington, representing constituencies never troubled with this grievous pest, have not, and cannot well have, any just conception of the magnitude of its devastations, and are consequently without due appreciation of the importance of the subject.

CATTLE IMPROVEMENT IN THE UNITED STATES.

According to the estimates of the Statistician of the Department of Agriculture there were, in round numbers, 28,000,000 neat cattle in the United States in 1876, valued at $640,000,000. In this estimate the average price of milch cows is placed at $28.29, and that of "oxen and other cattle" at $19.04. The low grade of the cattle of Texas and several other of the Southern States in part accounts for these low general averages for the country at large.

Mr. L. F. Allen, editor of the Short Horn Herd Book, contemporaneously agrees with the department as to the number of cattle, but raises

the total valuation to $1,000,000,000. In this aggregate he includes 15,000 thorough-bred animals of different breeds at $300 per head, and values the cattle of Texas and New Mexico at $10 per head. But either of these totals is sufficient to call attention to the magnitude of the cattle interest in the United States. If to either of these great amounts, representing simply an invested capital in horned cattle, the value of their annual produce in beef, milk, butter, cheese, hides, tallow, and hair be added, that interest will be found colossal in importance.

If it be true that the improvement of the common herds of the country by means of judicious crossing with animals of superior races will add from one-fourth to one-half to the value of the progeny and their produce, then it is not difficult to ascertain to what extent the wealth of the country might be increased through the general adoption of such a course.

Of course there are no means of ascertaining with any degree of accuracy to what extent the "grading" or crossing of common stock with thorough-breds of the various imported races has been carried.

It is safe to say, however, that out of the 28,000,000 neat cattle in the country the percentage of improved animals is quite inconsiderable, and these confined, for the most part, to those of the Eastern dairying States where improvement has been made on the common cow, and in several of the Western States where increased beef-production has been the object sought to be obtained. It is evident, therefore, in view of the comparatively small number of thorough-bred animals to breed from, and of the unaccustomed habits of our people in the practices of breeding and their undefined notions as to the importance of new infusions, that the task of raising the standard of American cattle must be one of gradual accomplishment. Fortunately for the American farmer he is not compelled to experiment with his cattle through many generations in order to develop and establish desirable qualities. He may find, within comparatively easy avail for the purpose of improving his own stock, races so thoroughly fashioned by the hands of successive breeders as to be almost worthy the name of creations on account of type-superiority. We are indebted to the persevering labor and unremitted experiment of English and Scotch graziers for the most valuable races which now contend for favor in this country. The power of transmission of cultivated qualities is one of the marked possessions of these animals, and upon this fact is predicated the possibility of carrying up the standard and the consequent profitableness of our cattle.

IMPORTED BREEDS.

The breeds introduced into this country for their superior milking qualities are the Ayrshire, from Scotland, the Jersey, from the Channel Islands, and the Holstein, from Holland. The Ayrshire is said to have originated in Ayrshire, Scotland, from the crossing of the English Shorthorn bull and the common Kyloe cow of Scotland, the progeny being thenceforward assiduously trained and cultivated as to their milking capacity, until, in this respect, the breed became distinctive and its qualities almost unerringly transmissible. Originating in the southwest coast of Scotland, in an open and rather inhospitable district, the animals are hardy of constitution. They put on flesh well when carefully fed, and when the cow is crossed with the Shorthorn bull the excellent qualities of both as to beef and milk are evenly developed in the offspring. An English authority says that cheese is the commodity most profitably made from the milk of Ayrshire cows in English dairies remote from towns, and that the average quantity manufactured is about 3½ cwt. per

cow per annum, although liberal feeding and good management in some instances have realized as much as 5 cwt. per cow. In the neighborhood of large towns, by direct sales of milk, four shillings a day are not unfrequently made from a single cow during six months of the year, and in Glasgow a cow-feeder is said to have made £50 in seven months by selling the milk of a superior Ayrshire cow. In size, the Ayrshires are much smaller than the Shorthorns, but somewhat similar to them in general contour, lacking the symmetry. The leading characteristics are a smooth appearance; the frame enlarging from the fore to the hind quarters; rather delicate, upward twisting horns; long face, with docile expression; straight back; large and full udder, with teats small and evenly set; color, brown or "reddish," with admixture of white. They were introduced into the United States about the year 1820, and their purity maintained in a comparatively large number of select herds, as is shown by the Ayrshire herd-books.

The Jersey, of the Channel Islands cattle, is the most generally known in this country, and has the reputation of affording an unusually rich quality of milk rather than a great quantity. Originally a native of Normandy, it has for centuries been isolated on the narrow little island of its name, the principal source of support of the inhabitants. It is related that in 1789 the Jersey cow was already considered so superior to any other then known that an act was passed by the local legislature prohibiting, under the penalty of 200 livres, the importation of any foreign breed of cattle into the island; and to this was also added the forfeiture of the boat and its tackle, and a fine of 50 livres upon every sailor on board who failed to give information of the surreptitious landing; and still further, the animals landed were doomed to immediate slaughter, and their flesh given to the poor. To this day no foreign cattle are permitted to be landed on the island, except as butcher's meat.

In this country, the Jersey Cattle Club exercise the strictest surveillance of importations in order to preserve the integrity of blood of the herds on this soil. There is a decided smack of aristocracy in the American-bred Jersey animals. The race is a dainty one, as may well be imagined. In England the cow is the pet of the nobleman's park; in America, the favorite of the family living in vicinities where the range of pasturage is small, inasmuch as it thrives well in the stall or small enclosure. For richness of cream and of butter to yield of milk the Jersey cow is not surpassed. Its butter is a luxury, commanding in the large cities from 60 cents to $1.15 per pound.

An Iowa dairyman informs the writer that "gilt-edge" butter cannot be made from the milk of the native cow any more than good Hamburg cheese may be made from skimmed milk, and that in his home market he gets from 80 to 100 per cent. more for Jersey butter than is obtained for the best grades of butter made from common cows, and still larger prices in Chicago and other large cities. The Jersey is smaller in size than our common cattle, somewhat angular in appearance and tender in frame, and is usually of a very deep-red color.

The Holstein is the most recent of the milking breeds imported into this country for trial, having been introduced by Mr. Chenery, of Boston, about fifteen years ago. Unlike the Jersey, this breed is remarkable rather for the quantity than for the richness of its milk; but it affords the advantages of being a good feeder and of laying on flesh in good proportion, thus enhancing the value of steer production. Tested near its own habitat, its milk production exceeded that of both the Ayrshire and the Devon, as shown by experiments made at two of the agricultural stations of Prussia. In the one case, with the same care and in the

same time, the Ayrshire produced 2,247 quarts, and the Holstein 5,677 quarts; the first consuming 9 pounds of hay for every quart of milk, and the latter 5 pounds. In the other case, 100 pounds of hay produced in the Hereford 15.97 quarts of milk, in the Devon 19.13, and in the Holstein 28.92. While it is generally conceded that the Holstein is much the superior of our American cattle, it has not been bred long enough here to have fully established its excellent qualities in public estimation. In size the Holstein is large and bulky, less elegant in frame and contour than the Shorthorn, and in color is a mixture of black and white.

The imported breeds more especially valued on account of beef-producing qualities are the Hereford, the Devon, and the Shorthorn. The first Herefords were brought to Kentucky by Henry Clay, who was a great admirer and patron of fine stock, in 1816. But, notwithstanding their well-defined excellences and great superiority over the cattle common to this country, for some reason not wholly explained this breed has not been as widely distributed nor attracted the public attention that its undoubted merits deserve. The race is highly prized in England, where, in some grazing districts, it is held in equal esteem with the Shorthorn, which it nearly equals in size and weight. It is a distinct race, however, purely bred, it is claimed, from a time long anterior to the development of the Shorthorn. The Hereford, as generally seen, is red in color, with white face, and frequently with white along the back and underneath the body. In England there are other varieties, presenting a mottled face and a gray or roan body, which is deemed to be the original type. In that country, according to an English writer, "the truest standard of form is still considered by many to be that of the mottled-faced breed, although, in other respects, the white-faced is undoubtedly superior; and as regards the form of the shoulders the breed stands pre-eminent, and produces comparatively little coarse meat in those parts; the hips, loin, and rump are equally good. The ribs do not spring out so wide as some breeds, but the sides can scarcely be found fault with; the twist is usually full and the chest well expanded." As a milker the Hereford cow is not highly valued.

The first importation of Devons from England was made in 1817 into Maryland, and another in the succeeding year by Hon. Rufus King, of New York. Others have followed at intervals, finding a permanent place, principally in the Eastern States. As in the case of the Herefords, they have not occupied as great a place in the public mind as their merits would fully warrant. But there are nevertheless a number of fine herds in the country, the purity of which has been maintained. It is claimed for this race that, as a distinctive breed, it is the most ancient in the United Kingdom. Mr. George Turner, an agricultural authority in Great Britain, said of the Devon tribe some years ago: "There is scarcely any breed of cattle so rich and mellow in its touch, so silky and fine in its hair, and altogether so handsome in appearance as the North Devon; added to which they have a greater proportion of weight in the most valuable joints, and less in the coarse, than any other breed, and also consume less food in its production." These animals seem wanting in nothing except the size and weight which distinguish some other breeds, and which are therefore more sought after on account of larger gross profits. "But," the suggestion is made, "large animals eat more than small ones, and it is still a vexed question, both with regard to sheep and cattle, whether little first-quality animals are not more profitable to fatten than those with more bulky frames that produce coarser meat and a larger proportion on the worst joints." The Devon is red in color; in size, medium. For centuries bred, for the most part, in the

hill regions of England, with little care as to shelter or prepared fodder, the race inherits stamina and hardy constitutions, and possesses milking traits in good degree, and easy of improvement through cultivation for that object.

Professor Lowe, in his work on "The Domesticated Animals of the British Isles," throws some light on the origin of the now admirable race of Short-horns. He says: "While Ireland and the western parts of England have been possessed for an unknown period of a race of cattle having long horns, and furnished with thick skins and abundant hair, fitted to protect the animals from long and continued rains, the eastern and drier districts toward the German Ocean have been inhabited by varieties of cattle having thinner skins, shorter hair, and horns *comparatively* short. In the fens of Lincolnshire and the other tracts of alluvial country toward the Wash, the cattle were of great bulk and coarse figure, and had, usually, a dingy color of the skin, and short, blunt horns. More inland, and following the course northward of the vale of Trent, and thence across the Ouse, and through the central plains of Yorkshire and the river Tees, and beyond it, the cattle assumed a less gross and unwieldy form, but were still a very tall race, of varied colors, with horns of medium length, but which might be termed *short* with relation to the same parts in the Longhorn breed." The race now distinctively known as Shorthorns is derived through the cattle of the Tees Valley, upon which the brothers Charles and Robert Colling instituted breeding experiments about the year 1777. Their bull "Hubbeck" was the progenitor of this now celebrated breed. The first importation to this country was made as early as 1785, and others have followed in more rapid succession that of Col. Lewis Sanders into Kentucky in 1817. They now very largely outnumber all other improved breeds in the United States, the Herds-Book showing a record of more than 60,000 well-bred animals. In England it is asserted that nearly two-thirds of the animals sent to London are Shorthorns or Short crosses. The admirers of this breed consider the animals as well-nigh perfection in symmetry. The handsome head is firmly set on a strong and muscular neck; there is great width and depth of chest, the shoulders shapely and well formed, and good breeders demand that "the barrel should be round, deep, and well ribbed up toward the loins and hips, which should be wide and level, with the back straight from the withers to the setting of the tail."

THE ANIMAL AND THE PEDIGREE.

In this country, as in England, the race of Shorthorns has attracted more particular and general attention than any other—a fact due, however, as far as the general public is concerned, more to the speculative interest that has been maintained for some years, carrying the prices of particular families and "fancy strains" to fabulous figures, than to an intimate understanding of the merits themselves of the breed. When a single cow is sold for $40,000 it is not surprising that the possession of extraordinary race-merits is attributed to the animal; but in what they particularly consist is not plain to ordinary ken. In fact, the actual advantages of breeding from certain imported or improved domestic live-stock is not popularly understood. A breeder of some note in this country, in a recent address on American agriculture, as an encouragement to young farmers to persevere in their calling, inasmuch as there are opportunities for very great and unusual gains afforded, cites the prices at which particular strains of animals have been sold. "We have seen," he says, "a single cow sold in this country at public auction for

over $40,000, and I suppose it is a fact that the late Mr. Hammond refused $30,000 for one of his rams. In one of the northern counties of New York, where the thermometer goes down to 40 degrees below zero, an American breeder had a choice herd of Shorthorn cattle; an English breeder purchased a part of the herd at a high figure, by telegraph. And only a few days ago an American breeder called to a brother breeder in England and bought his entire herd of thorough-bred Berkshire swine. * * * In England the offspring of a Yorkshire sow was sold for money enough to build a church, and in this country a breeder of Essex pigs has done nearly as well. The purchaser of a single pair of pure-bred Essex swine has sold pigs for over $10,000, and has a large herd left." It is not questionable that this sort of thing does more to prejudice than to subserve the interest of raising the standard of stock among us. It is very obvious that if $40,000 be paid for a cow, or $30,000 for a ram, the owner, if pursuing a *business for profit*, must ask for the produce of his animal extraordinary prices, very far beyond the reach of the ordinary or the prudent farmer. It may be that a suspicion of the meretricious is excited, or an indifference to the unapproachable thorough-bred engendered. There has been too much importance attached to the mere pedigree, and too little consideration of the intrinsic merits of the animal; too great desire to own an animal on account of the particular family it represents than for its capabilities in the direction of profit at the pail or at the butcher's block. "Fashionable" strains and fabulous prices have been the causes of incalculable mischief in the way of a wider breeding of a better class of farm animals, as, undoubtedly, the collapse in prices in 1875 and 1876, carrying with it the fortunes of many "fancy" breeders, fully proves. A just and enlightened view of this aspect of the subject was taken by the Iowa Breeders' Association, which met at Marshalltown in December, 1877. In this convention were gentlemen of note in the political and agricultural annals of the State, and breeders of established reputation. As opposed to the practice of buying and selling thoroughbreds as a mere speculation, it was unanimously declared by the convention "that no member has had in his possession *for five consecutive years* a breeding Shorthorn that has not proved a profitable investment of the capital employed." It was also declared that the objects ever to be borne in mind by breeders are the *improvement of the common stock of the country, and, where possible, of the pure stock itself;* and that the present depression in prices is the natural result of losing sight of the great objects of the business as above stated, and is of precisely the same character as the uniform results of undue excitement and speculation in every business or employment. Further, the convention unhesitatingly condemned, as destructive of the utility of the animals and the interests and profits of purchasers and breeders generally, the practice of high feeding, to excess, of breeding animals, too often indulged in under the stimulus of competitive sales or the mistaken demands of the show-ring. Nothing is truer than this, that practical farmers and breeders will not long follow the "traders" or speculative dealers in their race after mere fashion, and that there is a growing conviction that animals will be estimated according to individual worth in promoting certain ends—their intrinsic value consisting in the greater capacity of one animal over another to produce the larger amount of beef, milk, or butter of superior quality at less expense for feeding and with the smaller amount of care. Hon. David Christie, president of the American Shorthorn Breeders' Association, expressed the following views in his opening address at the annual meeting of the society, held at Lexington, Ky., in October, 1877. He said, "As an association we should not be unduly stringent in setting

up a higher standard than is meet. Let Shorthorn bulls of respectable pedigree be widely distributed, and we shall soon find that what is now styled common American beef will be a commodity of the past. To no other purpose can we so profitably devote our attention. The Shorthorn breeders, instead of having cause to complain of dull sales of bulls, will find their energies taxed to the utmost to keep pace with the demand. They will then also find that instead of males bringing disproportionately small prices as compared with females, they will be sought after at remunerative rates."

THE BREEDER AND THE FARMER.

Unfortunately, the breeder and the farmer have been standing apart, without apparent community of interests in their transactions. If the breeder's aim be profit, he should certainly keep in view the real, not the fancied wants of the largest constituency of customers, practical farmers, to whom it is a living interest to secure animals that will yield the largest and speediest returns on their investment. While it admits no dispute that the best animals are the cheapest, in the dairy, under the yoke, and at the shambles, yet the ordinary farmer cannot afford to pay an enormous price for a simple breeding animal, out of proportion to its actual intrinsic worth to him. It is not obvious to the plain farmer that he should confine himself to a particular strain, unless he be convinced that this particular strain or family will subserve the purposes of his farm economy. At the same time he desires animals of well ascertained purity of extraction. Nor is he disposed, usually, to purchase a thorough-bred of one race for beef-providing qualities and another for milk. Not all men are convinced that these qualities are respectively monopolized by any given race. In Scotland, the Shorthorn and the hornless Galloway are crossed, with excellent beef-yielding results, and in some of the dairies of Great Britain and Ireland crosses of all the leading races have been attended with satisfactory results. The best milchers do not always belong to the most valuable breeds; and it is a fact well established in our country that the progeny of the thorough-bred and the grade, and of the thorough-bred and the native, show improvements in some respects, as of fattening and milk-yield, over both progenitors. In England, the observation has been made "that the smaller breeds of horned cattle, as a general rule, produce better flavored meat than the larger, and the improved Shorthorn, with highly developed propensities of rapid fattening and of arriving quickly at maturity, fails in affording so acceptable a sirloin as the little Scotch runt that has roamed five or six years on mountains in a state of semi-wildness. Next to the Scots, in affording prime quality meat, we must class the Devons, and then the leading breeds of Hereford, Sussex, and lastly the Shorthorns; the difference in the flesh of all which breeds is sufficiently marked to become quite a peculiarity to the taste of the connoisseur." Mere pedigree is not an absolute guaranty that a particular animal is just the one adapted to a particular purpose. It is undeniable that the system of in-and-in breeding, continuously kept up in families with the view of maintaining the purity of their "blue blood," has a tendency to weaken vigor, type and race prepotency, and finally sterility and absolute degeneracy. Mere blood is nothing, if desirable qualities be not handed down. At the same time, pedigree, in so far as it is evidence of the establishment of desirable qualities and unquestioned prepotency, is of the greatest importance, nor should it be, under any circumstances, lost sight of or ignored. The Collings, Ellman, Bates, Hammond, who almost created new types of

sheep and cattle, and the Ohio breeder, who gave us the Poland China swine, deserve respect as public benefactors. Nor should the results of their patient and successful efforts be lost, on the one hand through careless subsequent breeding, or on the other through the inability of the farmer or breeder of limited means to avail himself of animals inheriting the improved blood. The aim of the original English breeders was not to create "lines of beauty" and to establish "points" pleasing to eye or touch, nor yet to breed animals that only those of plethoric purse could in coming time be expected to handle; but rather to improve on the breeds commonly known, with reference to the increased legitimate profits which might be derived from the superior products they might yield in beef, mutton, milk, butter, wool, &c. There would seem to be no good reason for stopping at the limits reached by those who have presented wonderful results in breeding, resting upon these results as the highest possible of attainment. In the form in which Mr. Joseph Harris, an intelligent American agriculturist, recently "put it," we repeat a fact that has caused no little investigation and experiment. "Notwithstanding all that science and art have done, the production of flesh, meat and fat, is still a very costly operation. To convert the carbon of gas and corn into the carbon of fat and butter, we have at present to submit to a great loss. Even with our best breeds of cattle and sheep, our most experienced breeders have to submit to a loss of at least 90 per cent. of the albuminoids of the food. In other words if you feed a steer or a sheep a quantity of grass and grain containing 100 pounds of nitrogen, you rarely get in the gross of the animal consuming the food, an amount of flesh, skin, hair, and wool containing 10 pounds of nitrogen. The other 90 pounds are to a large extent used to run the machine. Is there no chance for improvement here? We have the experience of the past and the science of the future to aid us. We have not to grope our way in the dark as Blackewell did. We know what we want, and in what direction to look for it. Depend upon it, we shall yet have breeds of cattle, sheep, swine, and poultry far superior as meat, milk, and wool producers, to anything the world has yet seen." But one particular problem in the breeding of the future is here named; there are others that need not be dwelt upon in this place. There is no more reason for breeders to stop where genealogies end, ambitious only to continue "in line," than for Amerigo Vespucci to have continued the hugging of known shores, because Columbus had discovered a new world, leaving nothing further to reward effort.

No class of agriculturists more need good animals than small farmers, and those carrying on that true system of farming which recognizes diversity as the touchstone of substantial success; because, on dearer lands, and consequently narrower cornfields and more contracted pasturage, they can, with profit, only raise animals that will make the largest returns. While a farmer at the West may raise a common herd at a fair profit, his brother at the East might on the same number of cattle suffer an absolute loss. Common cattle and improved breeds, side by side, may consume, respectively, the same amount of food, but when the selling-time comes the one will carry down the balance a fourth heavier and command perhaps from a third to a half more per pound on account of the superiority of its beef. He were an unwise farmer who, in the face of deterioration in quality and diminishing yield, persists in sowing a particular variety of wheat year after year when it is possible for him to obtain a vigorous improved variety, by means of which his profits might be very materially enhanced. And yet there are very many hundreds of just such farmers in this goodly land who are growing poor

with their twelve or fifteen bushels of low-grade wheat per acre, while with more careful attention to their fields, and the employment of varieties of seed-wheat well known to enterprising cultivators, they might double their yields, and much more than double their proceeds on account of the more marketable quality of the grain produced. No less unwise is he who is content to raise "scrub" stock, lean but voracious swine, and coarse-wooled and thinly-coated sheep, having in none pleasure, pride, profit, or incentive.

It ought to be within the reach of every farmer to produce good "grades," whatever the name of the thorough-bred animal with which the cross is instituted, whether Ayrshire, Hereford, Devon, Shorthorn, or other improved race, and by selection and attention in subsequent breeding, having sedulous regard for the plain principles with which every farmer should make himself acquainted, to bring up and maintain the standard of the cattle upon his farm. It is neither necessary nor desirable that the general farmer should convert his barns into breeding establishments, devoting his attention to breeding in "strains" and families of a fancy sort, at the expense of his legitimate farming operations. As illustrative of what a practical farmer may do by starting his herd in the right way, and afterward managing it with skill and prudence, the case may be cited of a gentleman who, at a Western cattle-sale in 1877, related that in 1868 he purchased his first Shorthorn heifer, for which he paid $100. Since that time he had sold seven young bulls for $1,065. At the 1877 sale he sold twenty-two females for $3,910, and five bulls for $635. He had still left five young bulls. In nine years and a half, as he relates, the produce of his one blooded animal numbered forty-two, with twelve heifers to drop calves within six months, and the amount realized in cash was $5,610.

If the production of beef or of milk be the especial object, it is within the power of the ordinary farmer to so improve his cattle that, for all practical purposes, he is about as well off as though his herds claimed full descent from the best names in the Herds-Book. The butcher is not a dealer in descent or families; nor will the cheese or butter monger ask if the products offered him are from Ayrshire, Devon, or Shorthorn, provided they suit his market. The grazier wants cattle that will feed and fatten well, and his practical eye will settle the value of the animal without reference to its pedigree; nor is he liable to ask troublesome questions about "Buzzard," or Galloway, or '17 blood that may have been filtering through generation after generation.

The case of Mr. Saume, of Kellogg, Iowa, as communicated to a Western journal, is here in point. That gentleman in the month of February, 1877, sold at the Union Stock-Yards, Chicago, sixty-four head of cattle. All of these were two years old and had been stall fed. A portion were natives or common stock, and the remainder half-blood Shorthorns. The former averaged 1,236 pounds in weight, and were, therefore, at that age heavier than average natives. These sold for $4.65 per cwt., making an average of $57.40 per head. The half-blood Shorthorns, on the other hand, weighed 1,666 pounds, and sold for $6.50 per cwt., or an average of $108.29 per head. This was a difference in favor of the grades of $50.82 per head; and the remark accompanies the statement, that at the Union Stock-Yards, where cattle are sold on their merits, the grades command from one to three cents per pound more than the best natives. This, for the reason that the offal of the improved stock is smaller in proportion to gross weight, and the carcass proportionately heavier in those parts which are most valuable, having less bone, shank, and unsalable gristle, with more loin, steak, and juicy roast.

THE DAIRY INTEREST.

The fact must not be lost sight of that good qualities may be *bred out*, or at least materially impaired. All practical breeders know that the milking qualities of some of the Shorthorn families have been to a considerable extent weakened through breeding processes, so that in some quarters they are avoided by those who desire profit from milk as well as from steer-raising. And yet it is known that in England this race is highly prized for the milk-producing quality, and that the original Bates herd, the descendants of which in this country command fabulous prices, was kept together as a dairy herd, unsurpassed in its milk and butter produce, and yet here the Shorthorn is usually looked upon as an animal for beef; and the impression prevails, more generally than it ought, that beef-making and milk-producing are not compatible in the same animal—a conclusion that is to be demonstrated. "By some singular means," says the National Live Stock Journal, "many breeders in late days have come to place a low estimate upon the milking qualities of their cattle. * * * To get the calf, and feed up the dam for show as quickly as possible, has been their rule. And, besides this, there has been an almost universal carelessness in the selection of crosses to perpetuate and develop the milking capacity of the animals. If the bull were a Kirklerington or a Rose of Sharon, a Duke, an Oxford, a Booth, or some other strain, whose pedigree happened for the time to be fancied, no question was asked as to whether his sire or dam were of a milking or non-milking family, and thus the great body of Shorthorn-owners drifted away, gradually but surely, from the true standards of excellence." The writer continues (after observing that the condition of the Shorthorn cow that makes her a poor milker is a purely artificial one): "The time is near at hand when breeders of Shorthorns will be compelled to pay more attention to milking qualities—when it will be said of an animal that her dam made so many pounds of butter in a given time; the dam of the sire gave so many thousand pounds of milk within the season, and the grandsire was the sire of the first-prize milk-cow at such and such fairs—the first among a hundred entries. * * * Farmers have no use for cows that simply raise a calf. They require a cow that will raise a big, stout calf, and more than pay for their keep besides at the pail. This is the kind of cow the breeders of Shorthorns must provide, and when it comes to be generally known that Shorthorn cows will do this, the demand for them among plain, practical farmers will surprise the most sanguine."

Mr. Talcott, of Rome, N. Y., who has been secretary of a cheese-factory in which the milk of 600 cows was used, says that the best of the number was a grade Shorthorn; and, taking the figures of a given month, the cows averaged a trifle over twenty pounds of milk each daily, as delivered at the factory, but this was little more than half what was produced from a dairy of grade Shorthorns, bred for the special object of milk. This gentleman prefers to use the Shorthorn bull on the Jersey cow to produce a good, rich milker for family or dairy purposes. He refers also to the unfortunate fact above alluded to, that some Shorthorn breeders have fed their animals too high for all practical purposes of breeding strong, healthy animals; and that, as one consequence, the milking qualities of their herds have been very much impaired. He cites a fact no less patent, that "the breeders of Jerseys are now following the breeders of Shorthorns in producing fancy animals with 'solid colors,' for sale at large prices, without regard to milking qualities." It is obvious, therefore, that the course pursued by some breeders, or perhaps "traders," in breeding the milking properties out of the Shorthorn

race is one destructive of their individual interest in the end. If it be designed to breed for beef only, their system will suffice for the grazier and the stock-markets; but for that large class, which constitutes the majority of American farmers, that expects profit from the cow in addition to that derived from her calf, this is not sufficient, and there remains the desideratum of an evenly-developed animal. It is not a purpose of this paper to discuss breeding problems, and the propriety of crossing, as suggested by Mr. Talcott, is simply mentioned here. Among many breeders in this country, we are aware that there is rather profound disgust for crossing thorough-bred races. The fact is in this place sought to be made prominent that the first-class animals with which we seek to raise the standard of our native herds should be such as to recommend themselves to the general farming community for profit, and to the purchasing community for excellence of produce. The meat interest is not the only one to be subserved in connection with our herds, large as that interest now is, and great as is the promise of the enlargement of its demands in the near future. Nor may farmers be expected to "bother" over races of animals for special purposes. The want is a "general-purpose" animal.

The dairying interest is one of vast and increasing magnitude. Its rapid growth in the East will be equaled and surpassed in some of the adapted States of the West. In 1840, in the great dairying State of New York, the entire dairy product, including milk, butter, and cheese, in value amounted to a little less than ten and a half million dollars, and in all the States to about thirty-four millions; but in 1869, according to the census of 1870, the milk and butter produce in New York alone reached the value of fifty-seven millions, and including milk one hundred millions. But in the city of New York, in 1876, the total value of milk, butter, and cheese received, according to the daily reports of the Board of Trade, was over fifty-five and a half millions. Coming westward, we find that in the single dairy product of cheese the State of Illinois advanced her yield sevenfold between 1870 and 1874.

Less than ten years ago (in 1869) Commissioner D. A. Wells estimated the value of the dairies of the United States at $400,000,000. In a paper read before the National Agricultural Congress at Philadelphia in 1876, Prof. X. A. Willard thought it much within the truth to state the value of the products of the farm dairies for that year at $600,000,000, illustrating the force of these figures by the comparison that in 1860 the total products arising from agriculture in the United States was estimated at $1,800,000,000; so that the dairy farms of the United States in 1876 produced a sum equal to one-third the value of the entire productions of agriculture, in all its branches, in 1860. The butter product of the United States at this time may safely be put at 1,000,000,000 pounds, and that of cheese at 300,000,000. The exports of dairy products in 1876 were: butter, 10,593,968 pounds, value, $2,230,469; cheese, 104,041,108 pounds, value, $14,069,391; condensed milk, $118,590, as against the following in 1870: butter, 2,019,288 pounds, value, $592,229; cheese, 57,296,227 pounds, value, $8,881,934; condensed milk, none.

In view of the refrigerative processes, which have, within the last two years, created our foreign trade in meats, it is not easy to estimate the possibilities of our coming foreign transactions in fresh butter. What then of the importance of the dairy properties of the several breeds of cattle through which our common stock is sought to be improved? In the Western States the Shorthorn race appears to be by far the most popular, and the greatest amount of "talking" is in their behalf. But in the West, with its large area of pasturage and cheap lands, the dairying in-

terest must, in the course of things, grow into now unthought-of importance.

In a paper read before the breeder's convention at Marshalltown, heretofore alluded to, Dr. Stevenson, of Indiana, indicated the feeling which is steadily growing at the West in regard to the dairying interest, the climate of the Western States, their cereals and grasses, the freedom from disease of the cattle, the multiplied lines and cheap mode of transportation pointing to dairy products as sources of wealth, &c. A large portion of the butter and cheese, says Dr. Stevenson, in the leading Western markets, in Chicago and Saint Louis, are manufactured north of the Ohio River, and a considerable portion in the Middle States. The increased attention to these products growing abroad will demand larger exports. The West, he thinks, has not contributed its share to the already large exportation of the produce of the cow, nor sufficiently shared its profits. For example, Iowa has a larger number of milch-cows than any other Western State except Illinois and Ohio, and of the Eastern States only New York and Pennsylvania exceed her. The number might well be doubled. The total value of products of the herd in that State in 1870 was $36,800,000; five years after, or in 1875, the produce increased to $42,629,039. In 1870 there were 369,811 milch-cows, producing 27,512,179 pounds of butter, 1,087,741 pounds of cheese, and 688,800 gallons of milk sold. In the following half decade the cows increased in number 303,712; increase in pounds of butter, 10,350,361; increase in cheese, estimated at 500,000 pounds, and gallons of milk sold, 2,616,600—an increase in the value of the dairy products in five years of nearly $5,500,000. Mr. John Stewart introduced recently, at Manchester, in that State, the manufacture of butter by the creamery system, which has proved an unusual success for an experiment. In 1875 he manufactured 66 tons, or 132,000 pounds of butter, most of which was sold at highly remunerative prices in the Saint Louis market. This gentleman's butter took the largest prizes at two successive Missouri State fairs, and was awarded the gold medal at the Centennial Exposition for the best butter exhibited in June. Referring again to Dr. Stevenson's paper the question of profit possible of attainment in the West through attention to milking properties of cows is very lucidly discussed. He says:

Feed a cow on a peck of corn-meal and twenty pounds of hay per day. Upon this she will do well, and, if a first-rate cow, will give six gallons of milk a day. I will take two cows, the owners of which are neighbors, one a two-year-old heifer from which seven pounds of butter are made weekly; the mother of this makes fifteen pounds a week. The heifer has now been milked eight months, and, although not giving so much milk as at first, makes her seven pounds of butter. At this rate she has made in the first eight months 224 pounds, at 25 cents—or $56. This heifer has been well kept, and has a heifer calf that cannot be bought for $20, which, added to the butter value, makes $76. A two-year-old steer of the best quality, and kept in like manner, will weigh 1,400 pounds, at $5 per cwt., or $70; that is, $35 per year for his keep. Whilst the heifer, with the addition of the labor of making the butter, gives $76. A peck of meal and twenty pounds of hay a day will keep a cow, and is worth, in Iowa about 11 cents, or $3.30 a month. Weight of food in eight months, 8,160 pounds. Fifteen pounds of butter a week, or 480 pounds for eight months, brings, at 25 cents, $120. Difference in weight of products, 7,680 pounds; difference in value, $83.70. To add the value of a good crop would increase it to $103.70. A number-one steer, of the best breed, a Shorthorn or a Hereford, as well kept as the cow, will weigh, at four years old, 2,000 pounds; worth, at 5 cents, $100, or $25 a year for keep. The food in this case is supposed to be the same. The annual result is, therefore, $78.70 in favor of the cow. Subtract labor and still there is a large margin in favor of the cow. There is still larger profit in converting the milk into cheese and butter. This depends much, however, on the skill employed in manufacturing the two articles. There is a greater difference in the price of common butter and the best than in the varieties of cheese; for, while first-class butter in the larger markets sells at 45 cents and the fancy article even very much higher, the largest mass of butter manufactured sells at an average of

20 cents per pound. Showing that a better class of butter in larger supply would command an intermediate higher price.

At one time there was a prejudice in Eastern markets against Western butter and cheese that is rapidly disappearing, and usually the creamery and factory brands of Wisconsin, Michigan, Illinois, and Iowa command quick sales at remunerative prices. It is sufficient, therefore, to say, in closing this branch of the subject, that the breeding interest must take strong and serious cognizance of the needs of the growing dairy industry if it would keep pace with the march of events.

THE BEEF EXPORT TRADE.

The export trade of this country in meats has already been alluded to. Its development and steady increase have been remarkable, and were perhaps wholly unlooked for less than three years ago. England has for some years imported large numbers of cattle and great quantities of carcass-beef from the Continent to supply her deficit; but that these could be transported across the Atlantic without injury or deterioration was hardly to be hoped. Nevertheless, the ingenuity of some of our enterprising dealers has made it both possible and profitable to themselves as well as, by the quality of their exportations, satisfactory to English buyers. The first shipment of American beef was made to England by Mr. Timothy C. Eastman, of New York, in October, 1875. The history of the enterprise, and the methods adopted to insure success by Mr. E. and others who entered into the business after his first ventures, are given in the Annual Report of the Department of Agriculture for 1876, and need not now be more particularly referred to.

English authority makes the statement that most of the live-stock from America is superior in quality and condition to that imported from Holland and other parts of the Continent, and that there is a juiciness and flavor about the beef and an equal distribution of fat and lean that are not wholly attainable except through the American system of full grazing. The British farmer is compelled to resort for fattening, in a great measure, to cultivated roots and prepared food, and largely to oil-cake. In this country "grass is king," and American cattle are "forced" only when corn and fodder are fed preparatory to marketing. It hardly seems probable that any other country can successfully compete with the cheap and luxuriant pasturage of the United States in a degree sufficient to interfere with the now-established meat-trade. An attempt has been made to create a business in canned beef to supply British markets, but there is a lack of "toothsomeness" about beef in this form that does not satisfy the beef instincts of the English public, even among the poorer classes. The idea has been entertained of importing beef from the great ranges of Australia, and large sums have been expended in the experiment; but the great ocean distance to be traversed and the warm latitudes intervening seem to preclude the hope of success, for in order to get the beef to England it must be thoroughly frozen. Even arriving fresh the excellent quality of the meat is not long enough retained after the thawing process to make it a paying investment at the butcher's stall. On the other hand, by the American refrigerative process, the meat is *not* frozen, but, on account of exposure to fresh currents of air through the compartments in which it is placed and remaining in a fixed position for from thirteen to fifteen days, the quality is improved, and its seasoning by hanging makes it even better, it is alleged, than the fresh products on sale in the English market.

It is interesting to consult the statistics of this newly-developed trade.

In the fiscal year of 1876, ended June 30, there were exported from the United States live cattle worth $1,110,703; salt beef, $3,186,304; sheep, $171,101; fresh beef (from October, 1875, date of first shipment), $349,100. In 1877 the export of live-stock (cattle) to Great Britain was $546,829; salt beef, $1,200,000; sheep, $22,578; fresh mutton, $36,480; fresh beef, $4,522,523. In one year, therefore, and that the second of the experiment, Great Britain alone purchased of us $4,589,003 worth of fresh meats. A comparison of our total meat exports of all kinds for three years, as appears from the annual reports of the United States Bureau of Statistics, is as follows: Total in 1875, $39,217,176; 1876, $49,592,834; 1877, $67,558,759, an increase in two years of $28,071,582. This trade it is believed will be followed in time by increased exports of mutton, and to some extent, perhaps, of fresh pork.

The people of Europe are not great consumers of pork, of which we are by far the largest producers on the face of the earth. And as long as every man in this country thinks he can afford to raise a pig cheaper than he can a steer or a sheep, the pig is destined to be popular, and we, ourselves, the largest consumers as well as producers. Mutton has not been as popular an article of food in this country, in comparison with pork and beef, as in Europe, whatever it may prove to be in the future; and thousands of sheep, it will be remembered, were, in the subsidence of the wool fever in the West, slaughtered for their pelts only. If a market is afforded for our mutton there can be no backwardness in the supply of as excellent a quality as can be produced in any of the sheep-walks of the world. It has been wisely suggested that England will not look to America for beef for her laboring classes, who must perforce live cheaply, but will demand beef of a superior quality for the large class in that country who are able to pay for it. Poor beef could find no market in that land of beef-eaters. Nor is it plain that it would pay American dealers to ship a poor animal or a poor carcass. If there is a difference of from one-fourth to one-half as between common and well-bred cattle in our home markets, which difference in most cases settles the question of either profit or actual loss for raising the animal, then certainly the superadded expense of shipment across the ocean would not favor the experiment of raising poor cattle for a foreign market. In establishing the export trade it has been asserted that the enterprising gentlemen who have been its promoters have exercised sound discretion in shipping carcasses of excellent quality. It is this fact, indeed, that makes the trade possible and gives to American beef a reputation of equality with the home product, or even superiority to a large class of it, opening for our product a large and constantly increasing market. It is quite certain that the wild herds of Texas cannot supply the demand for this export trade. If it should grow to much larger proportion it is evident that the grazing regions of the West must meet it. But as a condition precedent the standard of the common stock must be raised, and systems of feeding be adapted to secure the best quality of cattle at the least outlay. An additional incentive to the improvement of our herds exists in the fact that our own people, as they become more accustomed to what is excellent and desirable as a beef product, will be larger consumers of it, to the ultimate exclusion of that which is inferior.

CONCLUSION.

There is growing activity in the live-stock interest at the West. In Iowa, 81 counties report to the secretary of the State Agricultural Society the possession of herds, large and small, of improved breeds,

mostly Shorthorns; and West Liberty is becoming noted for its breeding-farms and live-stock sales. Within a radius of a few miles from that place there are more than 600 head of thorough-bred Shorthorns, held at an average of $300. In Illinois it is stated by Hon. W. C. Flagg, in the Report of the State Agricultural Society for 1876, that the number of thorough-bred cattle is very large, nine-tenths of them being Shorthorns, and the remainder Jerseys, Devons, Herefords, and Ayrshires, and that a considerable proportion of the common cattle of the country in many parts of the State have now an infusion of the blood of the various thorough-breds. The stock interest of the West has, in the National Live Stock Journal, published in Chicago, a very efficient and conscientious exponent and advocate. In the work of disseminating reliable and well-considered information on its specialty, it is ably seconded by journals of character in several of the Western States. The impulse given by these journals and the agricultural press generally, in connection with the various State breeders' associations, composed usually of substantial farmers, is apparent in the annually increasing attention given to the introduction of the better class of animals upon the farm. The columns of the journals mentioned are constantly presenting well-substantiated examples in proof of the assertion that it does not pay to raise a common animal on the farm. To some of these we have taken the liberty to refer, in confirmation of views expressed in this article. So thoroughly impressed was the Iowa State Breeders' Association as to the importance of directing more general attention to the subject of good breeding by presentation of facts and arguments, that, at its last meeting, it was resolved to hold a local convention in each Congressional district in the State at least once a year. And this resolution has already been put in practical operation, the convention for the second district having been held at Monticello very recently.

Mr. Pliny Nichols, of West Liberty, a breeder well known in the West, made a statement in April, 1877, of what results might be attained by good handling of common, grade, and thorough-bred cattle, respectively. Mr. N.'s prices are those of the Chicago market in 1877. The "results" are as follows: Common cattle, 3½ years, average 1,400 pounds, @ 4½ cents per lb., $63; grades, ½-blood cattle, 3 years, average 1,600 pounds, @ 5¼ cents, $84; thorough-bred cattle, 3 years, average 1,800 pounds, @ 6 cents, $108. Hence, with the same handling, the difference in price of grades over common cattle would be $21, and of thorough-bred over common cattle, $45. But by the common method of bad handling he estimates that we only get an average of $40 per head for our cattle, turned at three to five years. According to the biennial census of Iowa in 1875, there were 2,075,243 head of cattle in the State. Supposing that one-fifth, or say 400,000, were "turned" or sold each year, Mr. Nichols shows what would be gained by the State through the substitution of grades and thorough-bred, and the proper handling of them, over common cattle badly handled:

400,000 common cattle, common handling, at $40	$16,000,000
400,000 common cattle, good handling, at $63	25,200,000
400,000 grades, ½-bloods, good handling, at $84	33,600,000
400,000 thorough-breds, good handling, at $108	43,200,000
Profit of good over bad handling, common cattle	8,800,000
Profit of grades over common cattle, good handling	8,400,000
Profit of thorough-breds over common cattle, good handling	18,000,000
Profit of thorough-breds, with good handling, over common cattle, as commonly handled	27,200,000

"Granting," says Mr. Nichols, "that, as now handled, common cat pay expenses, the difference as shown above would be mostly net prof making a net annual profit of over $20,000,000 to the farmers, and cons quently to the State of Iowa, a profit sufficient to soon wipe out t mortgages on our real estate, and make us independent and prospero beyond calculation."

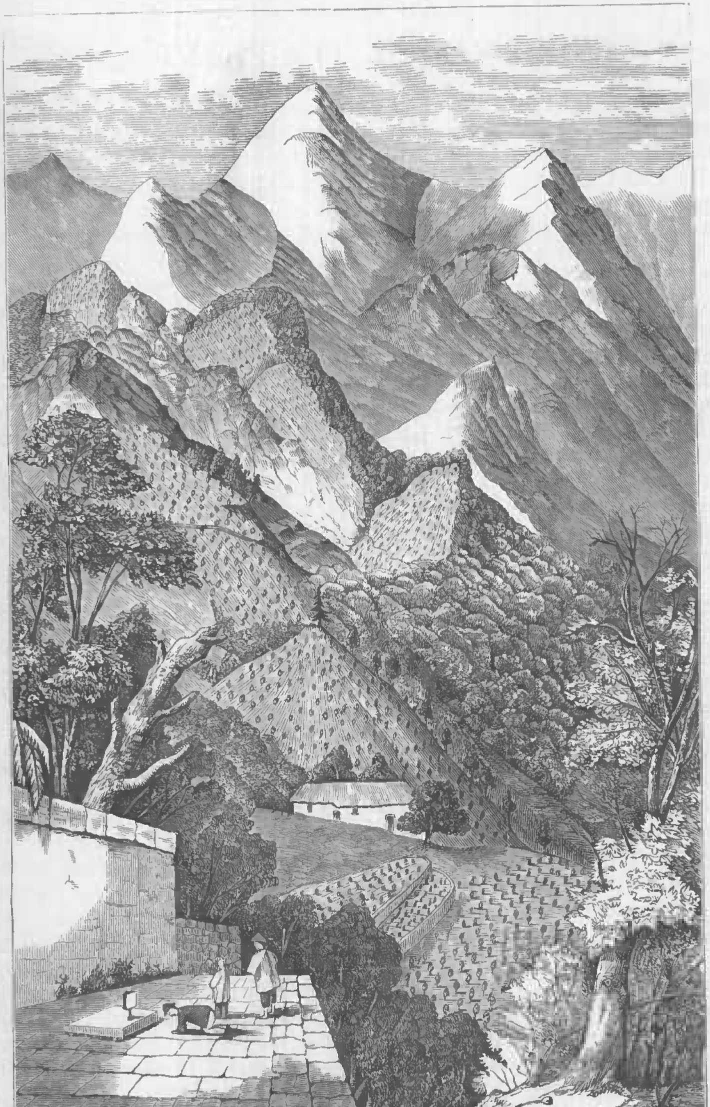
This article may be concluded by reference to a very convincing pra tical argument as to the difference between grades and natives as pre sented by the Broaddus steers. We condense from the facts as editorially stated in the National Live-Stock Journal of March, 1875.

At one of his sales, Mr. Reuben Broaddus, a large breeder, of Varna, Ill., sold 112 graded steers, 12 of which averaged 2,063 pounds, and the others 1,720 pounds. The price received was 6 cents, or 1 to 1½ cents more than the price of best natives. They aggregated 196,396 pounds, and all being 3 years old, he received $3,507 for each year they were kept. As natives would have been kept four years, or one year longer, to have been made fully ripe, he saved one year's keep, or $3,507, and they sold for $2,946 more than the same number of pounds of choice natives would have brought him, the two items amounting to $6,543. The natives kept until four years, and forced would still have weighed fully 100 pounds less than these grades, which, at 5½ cents, would have made an additional difference of $5.50 per steer, and, on the 112 head, therefore, $616. Adding this to the $6,453, we have $7,069, or in round numbers $7,000, as the difference in Mr. Broaddus' favor on the 112 grade steers over what he would have made had they been choice natives, or over $61.50 on each steer; almost as much as the native steer will sell for. This sale was made on the place, and the purchaser, Mr. Holderman, took the steers to Chicago and sold them in open market at 6¾ cents per pound, and on the same day, and under precisely the same influence, the choicest natives were only worth 5½ cents per pound, and native steers of average excellence but 4½ cents. Mr. Broaddus shortly after made a second sale of 70 steers at the same price, or 182 graded steers within 60 days at 6 cents per pound, realizing $19,058. Along with these he raised one native steer, of which he speaks as follows:

> To assist you in comparing the relative merits of grades and natives, I will give you my experience in feeding a native steer along with grades. * * * I had one native steer. I thought when he was two years old that he was quite good for a native. I fed him just as I did my grades, and when I delivered my stock to Mr. Holderman this native was over four years old, that is, one year older than the grades, and he weighed 1,640 pounds. I certainly did my best with him.

Mr. Holderman stated that he could well afford to pay about 1½ cents per pound more for grades than for choice natives. On these facts the National Journal bases the following forcible comparison:

> Now, let us suppose that one of Mr. Broaddus' neighbors raises natives, and gets the extra ones that he can bring up to 1,640 pounds, and turns off 182 of them. If market prices remained where they are, this neighbor, in twelve years, will have turned off three lots of steers which will have brought him in the aggregate $40,294.80, or for each of the twelve years $3,357.90. Mr. Broaddus in the mean time raising grades which at three years average 1,732 pounds, and sell for 6 cents per pound, will have turned off four lots in twelve years, bringing him $75,625.26, or $6,304.38 per year for each of the twelve years. In other words, Mr. Broaddus, by keeping grades and only the same number of head at a time, would only lack $411.42 per year of having an income double that of his neighbor keeping natives. And the figures are still further instructive; for Mr. Broaddus' neighbor in the twelve years will have turned off 546 head of steers, and made $35,358 less money than Mr. Broaddus. It is plain, therefore, that it would require nearly $65 per head on his 546 steers to bring his income up to that of Mr. Broaddus who keeps grades.
>
> Such is the difference which earlier maturity, greater weight in one year's less time,



Scenes in Black Tea District in Bohea.

and the increased price consequent upon the superior quality, makes in the profits of raising grades over natives. With all this difference resulting from the use of a thorough-bred bull, it seems strange that there should be any farmer too poor to buy a thorough-bred bull. The majority of them are in fact too poor to be without one.

THE CHINESE TEA-PLANT.

As the practicability of the cultivation and manufacture of tea from the Chinese tea-plant in certain portions of the United States has been demonstrated by successful experiment, it becomes an object of interest to know its history, to learn the manner of its cultivation and the method of its preparation.

Tea has been used in China for a period of more than a thousand years; yet the time of its discovery by the Chinese themselves is a matter of vague tradition only. An early writer claims that tea was known to the Greeks and Romans in the first century, but there is nothing in contemporaneous history to substantiate this claim. History is destitute, in fact, of any correct information of its use prior to the era of its introduction to the civilized world.

The Dutch East India Company first introduced it into Holland in the seventeenth century. In 1661 this company sent to the King of England two pounds and two ounces of tea as a rare and valuable offering, which was the first that was known of it in England. Six years later this company entered upon its traffic, and in a short time increased it to an industry of great magnitude, reaping from it rich profits, and contributing through its importation large annual revenues to the government.

This enormous trade from the East Indies, inaugurated by the Dutch company, incited competition, which resulted in the formation of the British East India Company.

More than two centuries after the general adoption of tea, this product, destined to become essential to the people of every nation, and to constitute an important commodity in the commerce of the world, remained hidden from our knowledge, and its culture and manufacture limited to the regions in which it is supposed to be indigenous.

In 1810 the first seeds of this plant were introduced into Brazil, at Rio de Janeiro, and their cultivation undertaken at the botanic gardens of that capital. The better to secure the success of its cultivation in that country, and with a view also of supplying the European markets, several hundred Chinese immigrants were procured by the government, who were familiar with the whole process of training the plant and preparing the tea. This was, perhaps, the first colony of Celestials that ever settled in the New World. They did not prosper, however. They soon became discontented with their expatriation, and after a little while entirely disappeared. The government failed in its experiment, but the planters of the country took up the subject and prosecuted it to some extent successfully for domestic uses. Rich in so many other products, the country did not engage in its cultivation as an article of export.

In the island of Bourbon, in the Indian Ocean, there is used a tea called *Faham*, or *Orchid* tea, whence it was introduced in France. It is different in taste from the Chinese tea, and is highly esteemed, having a delicate aroma and tonic and digestive qualities. It is sometimes used in making an agreeable perfumery. This tea is also cultivated in the

islands of St. Helena and Madeira; in the latter at an elevation, often, of three thousand feet above the sea.

They have a native tea in Arabia, prepared from the leaves of the *Catha edulis* (*Celastraceæ*), similar in taste and effects to the Chinese tea. It is a considerable article of commerce among the Arabs, and of general use with them as a common beverage. They use it also in chewing the leaves when in a green state to cause hilarity of spirits and to prevent sleep.

The inhabitants of the Malayan Islands have a beverage made from the leaves of a plant similar to the Arabian variety, and which grows upon high elevations and attains a great age.

In South Africa there is a tea called by the natives "bush tea," made from the leaves of a small bush of abundant growth, *Cyclopia genistoides*. It is of a medicinal character, and has the flavor and taste to a slight degree of the Chinese tea.

The United States Naval Exploring Expedition in 1857, while exploring the sources of the Rio de la Plata, found the inhabitants of Paraguay addicted to the use of a beverage which they called maté, or Paraguay tea. The shrub from which it was made was believed to be indigenous, and the leaves when fresh resembled in taste the inferior Chinese teas. The inhabitants attributed to it almost fabulous virtues. The leaves of the plant were used by infusion simply, all classes of persons drinking it at their meals. Its effects were similar to opium, exciting the torpid and languid, calming the restless, and inducing sleep. It was said to be in great favor as a beverage, not only in Paraguay and Uruguay, but in Peru, Chili, and Ecuador. The seeds of this shrub were brought home by the expedition, but nothing is known of their propagation. Several plants of the maté tea procured more recently from Paraguay, known as *Ilex cassine*, *Yaupon*, are now growing in the conservatory of the Department of Agriculture. It belongs to the well-known Holly family, which grows in a wild state in some of the Middle and Southern States, and from which tradition says the Indians of Carolina were wont to make a black tea for use on occasions of peculiar ceremony.

As far as known, tea-culture, other than for ornamental purposes, was first attempted in the United States by the late Dr. Junius Smith, at Greenville, S. C. This gentleman is said to have received the seed and probably some of the plants from a daughter residing with her husband, an English naval officer, in the East Indies. Unfortunately Dr. Smith's experiment, which, as far as prosecuted, gave excellent results, was terminated in a short time by his death. This, and a few other limited experiments in Georgia and in North and South Carolina, are all that go to make up the history of tea-culture in the United States. Its history for this country is, therefore, a history yet to be made. That it will be a history replete with important results, the conditions of soil and climate, no less than the character and requirements of our people, leave no room for doubt.

The immense difference of the conditions of soil, temperature, and geographical position under which the tea-plant flourished, proves that it is an extremely hardy plant, and capable of adapting itself to great variety of climate and circumstances.

In Japan tea is successfully cultivated as far north as 43°, where in winter-time the ground is frozen six inches deep for weeks.

In Java, where extensive tea-gardens are established, it succeeds under entirely opposite conditions of temperature.

In China it grows as well in the most southern sections, under a tropical sun, where the thermometer remains for long periods at 100° F., as in higher latitudes, when snow and ice often cover its tender leaves.

The Chinese tea-plant—*Thea viridis*, Linn.; *Camelia therifera*, Griff. (Chinese, *Chah;* Assamese, *Phalap*)—is described by botanists as a polyandrous plant, of the natural order *Ternstromiaceæ*. The flowers, which open early in the spring (appearing upon the plant about a month), are smaller in size and much less elegant than those which render some species of the *Camelia* so attractive. They are slightly odorous, and of a pure white color; they proceed from the axils of the branches, and stand on short foot-stalks, at the most two or three together, but usually solitary. There are five or six imbricate sepals or leaves supporting the blossom, which fall off after the flower has expanded, and leave from six to nine petals surrounding a great number of yellow stamens that are joined together in such a manner at their bases as to form a sort of floral coronal. The seeds are inclosed in a smooth, hard capsule, of a flattish triangular shape, which is interiorly divided into two, three, and even five cells, each containing a firm, white, and somewhat oily nut, from the size of a pea to that of a hazel-nut, of a nauseous and bitter taste. They ripen in some localities as early as October; in others not until January. The stem is generally bushy, with numerous branches bearing a very dense foliage, and in its general appearance not unlike the myrtle, though not so symmetrical as that plant. The wood is light-colored, close-grained, of great comparative density, and when freshly cut or peeled gives off a strong smell resembling that of the black-currant bush. The leaves are alternate, on short, thick, channeled foot-stalks; coriaceous or leathery, but smooth and shining; of a dark-green color, and a longish elliptic form, with a blunt or notched point, and serrated except at the base. It is needless to mention that these leaves are the valuable part of the plant.

The most extensive tea-culture, next to that of China and Japan, is found in East Bengal, in the provinces of Assam and Cachar. The tea-growing districts of these provinces lie between the 26th and 32d degrees of north latitude, and the 75th and 95th degrees of east longitude, which districts embrace a soil varied in surface, elevation, and composition, and a climate tropical, semi-tropical, and temperate. Here much care is exercised in the selection of seed. That from Assam is the most highly esteemed. Sometimes the seed are sown where the plant is designed to grow, three or four seed being dropped together and covered with two or three inches of earth. The plan usually followed, however, is to select a rich spot as a nursery, and to plant the seed there, one in a place. This allows a good ball of earth to be taken up with the plant at transplanting time. The seed are planted in December.

The tea plantations or gardens are always situated on the lower and most fertile sides of the hills, and rarely on the low lands. The plant thrives best when it enjoys a southern exposure to the sun, though it endures, as has been mentioned, considerable variations of dryness and moisture, and of heat and cold. A rich sandy loam in the vicinity of small streams of water is regarded as best for its growth. In any case care is had that the land selected is not liable to overflow, and preference given to that which is either naturally or artificially drained. Many prefer to plant in beds 25 to 30 feet wide, with good drain-furrows on either side. Before planting, the land is deeply plowed and thoroughly pulverized by repeated harrowing.

In April and May, when the plants are about twelve inches high, the land to be planted is checked off 3½ or 4 feet by 4 feet. The plants are now carefully drawn from the nursery, with a ball of earth attached so as not to expose the roots to the sun, taken to the garden in baskets, and planted in the "check"; using for the purpose an ordinary garden-trowel,

such as is generally employed in this country in setting out tomato or other plants. Pains is taken to keep the nursery entirely free from weeds, and all vacancies, from whatever cause, are quickly supplied. In the early stages of the growth of the plant, shading is undoubtedly advantageous, as the roots are sensitive to the heat of the sun. This is done by sticking about them pine branches and ferns. After the first year they supply their own shade. During the first two years little or no cultivation beyond that necessary to keep down the weeds is given. When the plants are two years old they are pruned down to about 18 inches; January is regarded as the best time for this. The plants commence in February to throw out young shoots, and are allowed to grow up into good vigorous bushes before any picking is attempted. About August sufficient leaves are picked to form the bush, and this is continued from time to time till the end of November, when it is a well-formed plant from 4 to 5 feet high. In December it receives its second pruning, which requires more care and watchfulness on the part of the planter than at any other time; for, so to speak, this pruning forms the body of the bush that is to provide wood and leaf for future seasons. Such is the comparatively simple and easy mode of propagating and cultivating the tea-plant in the British colonies in India.

In Japan the plan pursued does not materially differ, as will be seen from the following translation (made by a member of the legation, from a Japanese work on the cultivation and preparation of tea), which, through the courtesy of the Japanese minister, the department has been permitted to use:

The best season for sowing the tea-seed is some time in November and December, and also in the early part of spring, when the mercury stands at about fifty degrees, but the earlier it is sown the better. The first appearance of the new buds will be in the next May, and they grow gradually onward. If the seed is sown during the winter months, it is necessary to protect it by some means from snow and frost; that sown during the winter months takes root before sprouting, and consequently its growth is more rapid and prosperous. On the contrary, if the seed is planted in the latter part of spring, it cannot take much root, notwithstanding the fertile soil and warmer air of the season. There are two ways for planting the seed, namely, circle planting and straight-line planting.

Direction for the former: Draw straight lines lengthwise upon the ground intended for plantation, two feet apart; and also draw lines perpendicular to and cutting the first-mentioned lines; at the intersection, dig holes about fourteen inches in diameter and two feet deep, and after removing the stones, pebbles, bricks, &c., from the soil, replace the latter in the holes. Then deposit manure upon each of these holes sufficient to cover the surface, and let it remain for one or two days to be absorbed and dried up. After that, drop the seeds around the inner edge of the beds and lightly scatter the soil over the beds about one inch thick. The seeds for one bed number about one hundred.

Directions for the latter mode of planting: Prepare the ground in straight continuous lines about five feet apart (thus allowing some cereals to be sown in between these rows, if desired), and sow two seeds in one spot, leaving a space of two inches between the spots. As the very young tea-plants cannot bear cold, frosty weather, they must be tended with great care, particularly during the *first* winter. In the first place, to protect them, put one peck or so of rice or wheat husk or some straw around the roots, and scatter dirt to keep it from being blown off by the wind. In some way or other they must be kept from the cold wind, frost, and snow. Sometimes straw, pine or cedar boughs are set around the bushes. Thus keep them until the season of frost is over, say till about the first of April of the next year; and, when the proper time arrives, the wrapping should be taken off, remembering that the same protection is required until the third year.

The use of manure is not particularly needed until after the first year is over; but if at all applied, very weak manure should be used. In the second year a little richer fertilizing is required, say one flour-barrel full of water with half a gallon of manure. In the third year a large quantity of oil-cake is desirable (residue of rape-seed after oil is extracted); if this manure is applied, put about fifty barrels of manure to about one rood, and to obtain the first quality of tea it requires twice as much manure. There are many ways for fertilizing. In some places manure is applied in the month of May,

just after plucking off the leaves, when you pour manure-water; and in some places manure is applied in mid-winter, or in the latter part of January. Thus, in one way or another, there are three times for enriching the soil in one year. In some places very weak manure is occasionally used, sometimes oil-cake mixed with manure—seven-tenths of oil-cake with three-tenths of manure. The quantity of manure varies according to the quality of the soil. There is one particular way of applying manure, and it is this: Take a rod or stick and insert it some inches deep in four or five places around each bush, then pour manure into each of the little holes thus made. If manure is applied closely around the plants, it not only does not reach the roots, but destroys the tender leaves.

Great care in manuring is necessary, because the quantity of the new leaves differs according to the proportion of manure and the skillfulness in applying it. One flour-barrel of human excrement should be mixed with two barrels of water. Mix fourteen ounces of oil-cake with twice as much water and let it be in this state about ten days, until it becomes stagnated, and add to it the same quantity of some other stagnated water to moderate it, and even when using this kind of manure the bushes will overgrow and the leaves will wrinkle if the tea-plantation is far off from the human habitation. Sometimes dried fish are used as manure, but this is inferior to oil-cake, and although it will give brilliancy to the leaves, it will also give a darker color and a bad smell.

The new buds will gradually shoot out about sixty days after the seeds are planted—that is, when the mercury reaches to about seventy degrees. If the ground is too dry, water should at this time be sprinkled upon the plants. Those sprouting out with a pair of buds are female plants, and the male plant grows singly. They grow about two inches by the next winter; by the second, six; and eight inches before the third winter. In the latter year the taller stems should be trimmed, while the lower ones should be left to grow, in order to bring them to an equal level; and in the fourth year the same process is also required; but in the fifth year every one of them must be trimmed so as to be of the same height, to make the bushes dense and compact.

By favor of the State Department we are furnished with a set of paintings illustrating the growth and manufacture of tea in Japan. Plate 1 shows the condition of the leaf and stalk at the end of the first year.

Picking is not begun in Japan until the plants are three years old. It usually commences in April, after heavy rains, when the shrub shoots forth leaves, vigorously and abundantly, and continues through May and June; but the late leaves are larger and not considered worth so much as those first gathered. In Japan only the first three leaves of every stalk or stem are picked, while in India they take six leaves, (Plate III, Figs. 2 and 3.) The last figure shows at *a* the bud before it is developed into a leaf, and appears in the tea like a grain of silver, owing to the white downy or hairy cover. (The name of Peekoe tea in China is derived from this appearance, as Pe-koa signifies white hair.) *b* and *c* make the broken Pekoe, *d* and *e* the Pekoe Souchong, third quality, and *f* makes the Souchong of fourth quality. This comprises the average list of teas manufactured in India. The process of plucking is as follows: The woman plucks *a*, *b*, *c* at [1], with the thumb and forefinger of the right hand; *d*, *e*, and *f* are torn off at the places marked [2], [3], and [4], leaving enough of the leaf to protect the small bud that will form and develop into shoots.

There is also an autumnal gathering, which, however, affords weak tea of inferior quality. In the successive gatherings the young and succulent leaves only are chosen, for if the leaves are permitted to attain their full growth they become harsh, fibrous, and brittle, and cannot be made to assume the twisted form, but remain flat, coarse, open, and yellow, and are unfit for tea.

If a proper system of pruning has been adhered to, the plants will all come in "flush" (a term denoting the period of "tipping" or budding) about the same time, rendering the operation of picking much less difficult.

The process of picking in Japan is further described, in the work from which we have just quoted, as follows:

The first picking takes place in the third year. In the month of April, when the mercury stands at about sixty-six degrees, shoots come out from the older boughs with

about five leaves, and three of these should be plucked off with care, so as not to touch the stalk with the finger-nails. The time for picking the leaves differs according to the temperature of the season; yet the latter part of March, when the mercury may stand about sixty-six, and also about the 10th of May, are considered to be the best seasons.

On their first appearance the sprouts look somewhat like the head of the ordinary writing-brush (Japanese). Two or three leaves will gradually come out, and they will perceptibly grow every day larger, thicker, and more tender, and will have a very fine flavor. This is the very time to pluck them off, and this is known as "two or three leaves plucking." When the picking is delayed till four or five leaves come out the tea loses its flavor, becomes coarser, and will be of inferior quality. During the early part of the season the garden must be watched every day to see whether the time has come or not to pluck the leaves.

The larger shoots should be plucked off first, and the younger ones must be left to grow. After the first picking is over some shoots will still come out, and these should be trimmed in order to realize a second crop in due course of time. About thirty days will elapse before the second crop will be ready for picking—say some time in May, when the mercury stands at about seventy-three degrees. After this the stems or stalks should be trimmed so as to make the tops of the bushes level.

Latterly, owing to the increased demand and consequent high prices of tea, the third shoot is also picked; and this is done in June, when the thermometer stands about eighty-four degrees. Thus three crops can be taken annually, but the last plucking materially interferes with the crop of the next year. The first plucking of the new leaves should be done in the third year, as already mentioned. In the sixth year about thirteen ounces of fresh leaves may be obtained from a single bush. The leaves which have been picked off within ten days from the commencement of the season (the latter part of April, when the merour ystands at about sixty-six) are known as the first class in quality, and those taken off about fifteen days afterward, the second class. The quantity of one day's yield, for a female laborer, is from ten and a half to thirteen pounds. The best hours for this labor are from early morning until 2 o'clock p. m., and the leaves which may have been picked off after that hour should be cured on the following day. The proper way for keeping them through the night is to spread them on the mats, and keep them outside, if the weather be not very damp. This is done to keep the leaves from shrinking too rapidly. But, if the weathei is damp, they must be spread under shelter so constructed as to admit a free circulation of air.

In any case, the operation of picking is one of great nicety and importance. Each leaf is plucked separately from the twig. The hands of the gatherer are kept clean for this purpose. In picking care is taken to pluck only about two-thirds of the leaf; one-third being left to protect the new small buds from injury. The tea is gathered while the leaves are small, young, and juicy. The first collection of tender leaves makes the best variety of tea. Women and children are generally employed in the operation of picking, in performing which a small basket is hung at the side of the picker and a large one deposited for general use. When two of these large baskets are filled, a man carries them to the drying-house (Plate II, Fig. 4).

The Chinese dislike gathering tea on a rainy day, and claim even that they can distinguish teas made on a rainy from those made on a sunny day.

This account, taken from various authorities, of the mode of propagating and cultivating the tea-plant, and of gathering its leaves in Asiatic countries, and which mode is equally adapted to certain parts of the United States, being deemed quite sufficient for the requirements of the many intelligent agriculturists of our own country, who sooner or later will engage in tea-culture in an organized manner and as a paying business, we pass to the somewhat more difficult process or processes of manufacture. These processes it will be seen vary considerably in different countries.

In Japan, the leaves as they accumulate at the drying-house are placed in a broad, flat basket of about 30 inches in diameter by 3 inches in depth, and deposited for about 60 seconds in a steam bath, covered with a wooden lid (Plate III, Fig. 5). The leaves when taken from the steam

bath are then spread upon mats and cooled (Plate III, Fig. 6). The only apparent effect produced upon them is a softening and shrinking of the leaf and a slight diminution of freshness in color, while it causes the leaf to retain its green color in the dry state, thus making *green tea.*

About five pounds of the steamed leaves are then carried to pans or furnaces, which are made of stone, plastered outside, about 3 feet high, 3½ feet long by 2 feet wide, (Plate III, Fig. 7). In the interior, and close to the ground, is made a charcoal fire, which is not fed through any hole at the side or beneath, but is supplied at the top. Upon and inside this top is placed a gridiron (Plate III, Fig. 8) as a supporter, over which is placed a paper tray into which the leaf is thrown. This tray has a wooden frame with a bottom of 5 to 6 thicknesses of tough paper (Plate III, Fig. 9), which rests upon the gridiron. As the heat acts upon the leaves, a man (there being one for each furnace) agitates and stirs them with his hands (Plate IV, Fig. 10), then he kneads the mass of leaves as the housewife works dough, being careful to keep the whole mass in motion. This rolling, kneading, and working continues for about an hour, when he removes them to the mats for cooling, and where those leaves which have not yet assumed a distinct twist or curl are picked out carefully, while the remainder are again placed on the tray for additional drying. Again the whole mass is removed to the mats for cooling, and still again placed in the trays for drying. This alternate heating and cooling produces the color, as with each successive drying the leaf takes a darker shade.

Bamboo baskets of about 2½ feet in diameter by 3 inches in depth are suspended from the ceiling by small cords (Plate IV, Fig. 11). The bottom of these baskets are of fine split bamboo, made with interstices, varying according to the fineness desired. This grades the tea. Again the paper tray receives the tea, which is slightly agitated for about 15 minutes for giving the leaf a smooth surface and brightening its color. The tea is now placed in bamboo scoops, and by a dexterous tossing motion the dust is entirely fanned out. From this the tea is taken to long and low tables (Plate V, Fig. 12), where any remaining stems or uncurled leaves are carefully picked out by women or girls. Only the very best tea is placed in jars; the majority is placed in rough boxes, covered with paper, weighing about 110 pounds when ready for shipment.

The Japanese tea in its pure and natural state is a long, well-twisted leaf, with but little dust or broken leaves in it, and of a brownish green and not of a yellowish or grayish green color.

The tea-leaf in the different *rollings* it undergoes in the process of manufacture, as practiced in Japan, is shown in Plate IX. Fig. 30 represents the leaf in the natural state when first picked. Coming from the steam bath it has a withered appearance, as in Fig. 31. Figs. 32, 33, 34, 35, and 36 show it after the first, second, third, fourth, and fifth rollings respectively, the last being the finished product.

Another Japanese method of curing tea is given in the work from which we have twice before quoted, and is as follows:

The leaves are carried in from the field, and by means of sieves the two small bracts attached to every stem and broken or fragmental leaves must be separated from the good and whole leaves. The old leaves, sticks, &c., should also be carefully separated from the good leaves. It is always the best way to prepare the leaves on the same day they are picked; for if kept through the night their quality is somewhat impaired; if two nights be allowed, they will lose much of their flavor; therefore, the quantity to be picked must be calculated according to the number of hands and heaters (or hoiro, a utensil made of thick paper, with frames, for the purpose of heating the leaves). The fire-place must be built large enough for a boiler about two feet in diameter; fill this boiler with eight-tenths of water, and boil it until it reaches two hundred and twelve degrees. When the steam rises, a square piece of cedar board with

a large hole in the center is fixed on the boiler. On this board, and around the outer edge of the circle, is placed a circular mat, made of rice straw, to prevent the steam from escaping, and on this mat is placed the steamer.

Then about half a pound of the green leaves are put in the steamer and covered. After thirty seconds the cover is taken off and the leaves are stirred up by means of small wooden sticks, made of *Paulownia imperialis*. The same process is repeated thirty seconds afterward. The leaves soon become adhesive, and have a tendency somewhat to cling to the sticks, and this is a sign that the steaming is done. This is the time to take them aside and put them in a cooler place, and this is done by turning the box upside down, as the steamer, which is on the bottom of the box, will come out at the upper part. Then spread the leaves, cooling them with fans, and after they become cool enough put them into baskets, and get them ready to be sent to the heating department.

In heating, a place must be arranged three feet wide, six feet long, and about three feet high, plastered inside and out with mud. Burn in the furnace about twenty pounds of oak-wood charcoal. When the fire becomes hot, put in two or three bundles of straw in order to make the heat softer; then put iron bars across the furnace and the copper-wire nets over the bars, and spread the heater (of thick paper) which is made to fit the place. Four pounds of the steamed leaves may then be scattered on the paper; rub them very softly with both hands; winnow or throw them very lightly, and stir them. This ought to be skillfully performed, so that the proper color and flavor may be secured. Then they must be taken aside at the moment when they are almost dry. When the day's work is over, take the fire out from the furnace, and prepare as was done before; then scatter the leaves which were heated during the day, drying them in this way during the night. At this time about twenty-four pounds may be spread over, but it requires great experience to heat them in this way. The softer heat is preferred to the greater heat. The quantity of the best tea which may be prepared by one laborer per day is about thirty pounds on an average; and the quantity of the inferior quality, from twenty-eight to thirty-seven pounds. About one pound and three-fourths of tea is generally made out of eight pounds and five ounces of the green leaves.

For the finishing process a sieve should be used, in which the dried tea is to be softly rubbed by the palms of the hands, separating the tea from the stems. The next process is to separate the tea from dust, sticks, stems, &c., by winnowing; and if this is difficult to do, put them on a stand and sort them into two or three classes, and then use a finer sieve. After this has been done five or six times, separate the larger leaves from the others, and so on with the finer leaves.

Numbers 2,* 3, and 4 of the sieves are used for the inferior tea, shaking the leaves through two or three times. The sieves numbered 4 and 5 are required for a second-class tea, and it must be passed through them twice. For first-class tea, the sieves numbered 3, 4, and 5 are used respectively, and then it must be passed twice through No. 6. Sieve No. 1 is only used for a very common tea, and Nos. 7, 8, 9, and 10 are used for extra fine quality.

In China tea is made in two different ways from the same plant, the difference in manipulation resulting in the *black* or the *green* tea.

When black tea is to be made, the leaves are sorted and put in process of manufacture the same day. They are exposed to the rays of the sun in sieves made of bamboo until they begin to shrivel, which is accelerated by beating them between the hands. The sieves are placed on stands, which are arranged obliquely, and usually contain about three rows of trays (Plate IV, Fig. 13). They are raised two feet from the ground, and incline outward at an angle of 25° toward the sun.

The finest Souchong and Paochong teas are prepared from the most delicate young leaves. These are gathered in the finest weather, and are dried in the *shade*, as exposure to the direct rays of the sun would injure their quality. Leaves of an inferior quality and such as have been gathered in rain require to be dried over or before a fire previously to being roasted, for if turgid with juice they would be boiled rather than roasted

* Sieve No. 2 is 2 feet and 2 inches in diameter, arranged with eye-holes three-tenths of an inch square, made of split bamboo one-tenth of an inch wide. No. 3 sieve is 2 feet and 1 inch in diameter, with eye-holes one-fifth of an inch square. No. 4 sieve is 2 feet in diameter, with eye-holes two-tenths of an inch square. No. 5 sieve is 1 foot and 9 inches in diameter, with eye-holes one-tenth of an inch square. No. 6 sieve is 1 foot and 8 inches in diameter, with eyes five-tenth inches square. The depth of these sieves should be about 3½ inches.

in the pan or kuo. They are dried usually in a room fitted up with framework to receive the sieves, beneath which charcoal fires are built in earthen pans (Plate IV, Fig. 14). After being dried, the leaves must be cooled to check fermentation. For this purpose they are placed in three layers upon bamboo trays arranged on tall stands and exposed, in shady situations, to the wind, in the open air or in a building which admits a thorough draught through them. Here they remain until they emit a slight degree of fragrance, when they are sifted and tossed about with the hand and arms (Plate IV, Fig. 15)—an operation kept up until they have acquired the necessary degree of fragrance, when they are ready for roasting. This is done in a shallow and very thin iron vessel of a circular form, without handles, and which is called a kuo (Plate VI, Fig. 16). It fits horizontally into a stove, with its rim even with the upper surface of the brick-work. The fire-place is on the back side of the stove (Plate IV, Fig. 17). The roaster, standing on the opposite side of the fire-place, throws about one-half pound of leaves into the kuo at once. He then places his hands upon the leaves and, with a slight degree of pressure, draws them from one side of the kuo to the other, repeating this motion until the leaves are sufficiently roasted. Great care is requisite that none of the leaves burn at the bottom of the vessel, as this would impair the flavor of the tea. The roasting is continued until the leaves give out a fragrant smell and become quite soft and flaccid, and then they are immediately rolled or kneaded with the hands upon a tray of bamboo-work of a circular form (Plate VI, Fig. 18). The roller places as many leaves upon this tray as he can cover with both hands. The leaves, being rolled to and fro, become twisted, and are kept in this condition by the viscous juice expressed. They are now spread out on a clean tray and placed on stands, to remain until all the fresh leaves are roasted, when they undergo a second roasting, which is shorter and slighter; then they are removed and cooled; after which the first operation is begun again and repeated so long as any juice can be expressed in the process of rolling. When that ceases to exude they are in a condition to undergo the final desiccation, which is conducted in open sieves over a bright charcoal fire, and requires a great watchfulness that no leaf fall through the seive into the fire, giving rise to smoke, which would injure the flavor of the tea. The sieves are now placed in a cylindrical basket, slightly contracted in the middle (Plate VI, Fig. 19), about 2½ feet high and 1½ in diameter, open at both ends, and covered on the side with paper. A little above the contracted part two cross-wires are placed, for the purpose of supporting the sieve containing the tea. The drying-tube, covered with a bamboo tray at the mouth and containing the tea, is placed over a low stove built upon the ground, filled with a small quantity of charcoal. The stoves are constructed within a continuous piece of brick-work, coated with plaster, extended round the three sides of a long and narrow room, the brick-work being about 6 inches in height and 2 to 3 feet in depth from the front of the wall. A considerable quantity of steam escapes in this process. The leaves remain about half an hour in the drying-tube, occasionally being turned and tossed, and are then taken out and rubbed and twisted between the hands. This rubbing, being accompanied by a slight degree of pressure, twists the leaves in a permanent manner and gives them their black appearance. The leaves are now repeatedly brought to the drying-tube until they have assumed the necessary dryness and color. When the leaves become quite crisp, so as to break easily with the slightest pressure of the fingers, the tea is finished and ready for packing.

It is best to pack the tea while warm, taking care also that the box is perfectly dry.

The methods here described apply to the best kinds of teas; the manipulation of inferior kinds is carried on in a much simpler way. Some are simply dried in the sun, rolled by means of a channeled and roughened stone (Plate VI, Fig. 20), with hollowed sides for the convenience of lifting, the balls of leaves thus produced being pulled to pieces and the operation repeated several times after continued exposure to the sun. Tea thus prepared has a fragrant smell and a red color, with a sweet taste, but is not calculated to keep well.

Pekoe tea, the finest and best of all black teas, is prepared, as stated before, from the leaf-bud before it is expanded. It was erroneously supposed to be the blossom of the tea-plant, hence the French name, *fleur de thé*. The tea-blossom itself has but little fragrance and is never mixed with imported tea, although sometimes used in China. This tea is very slightly rolled if at all; it is dried in the shade, then over a slow fire, and lastly in the drying-tube.

Songy or *caper tea*, so termed from the resemblance of the roundish pieces of which it consists to the caper, is prepared only from the largest of the young and succulent leaves, each leaf being picked separately from the plant. This tea is prepared or cured by a series, so to speak, of short dryings and rollings, causing it to stick together in balls, which, when broken, do not fall to pieces in separate leaves, but in fragments; these are molded in roundish modules, and it is from these that this tea has received its English name.

Bohea tea is the coarsest kind that is exported, consisting of the full-grown leaves, which remain on the shrub after the regular harvest, and which are collected in a rough manner, exposed to the sun for a short time and then packed in baskets, which in Bohea are sent to the purchaser's own curing-house; but, in the Wo-King country, are generally packed in tubes and sent to Canton to be roasted. There it is sifted, assorted, and loosely repacked in open-work baskets for the better admission and circulation of air, the inside being lined with soft paper to prevent loss of tea. These baskets are now laid on their sides and arranged in tiers upon an open frame-work on both sides of the long and narrow room; the floor of this room has a channel or flue 16 inches wide running its entire length filled with burning charcoal, and thus heating and drying the tea in the baskets (Plate VI, Fig. 28). The roasting usually lasts three days. The tea thus roasted is mixed with other and better kinds, according to the quality required, and is ultimately packed in large boxes or chests containing an average of 172 pounds.

The leaves intended for *green tea* are spread out in layers upon hurdles in a kind of box made of bamboo, the bottom of which forms a water-boiler. The steam passing through the leaves soon withers them; they are then rolled and placed at once in an iron pot to dry. The light color of this green tea is accounted for by the fact, well known to collectors of plants, that many plants (like the *Orchideæ*) which inevitably turn black when simply dried, preserve their green color when wilted by steam previous to drying between blotting-paper. Green tea retains more juice in drying than black tea, a circumstance which explains its more energetic action upon the nervous system. All green tea comes from the province of Kiang Nang, and was originally called Singlo, from a hill where it was grown and prepared. Being afterward introduced into the plains and having more attention bestowed on its culture, it received the name of *garden* tea, and ultimately *Hyson*, from the firm or mark, Hee Chun, of a distinguished manufacturer.

But the Chinese have a simpler way of manufacturing green teas. In this, the leaves are placed as soon as picked in a vessel of deeper form

than that used in making black teas. This is placed in a brick stove at about five inches below the level of the surface of the stove (Plate VI, Fig. 22) and heated very considerably above the temperature that can be borne with the hand, in fact nearly to a red heat. Half a pound of tea-leaves is thrown in and stirred rapidly about, producing constantly a crackling noise and a great quantity of steam, which, from the depth of the pan, cannot escape so readily as from the shallow kuo used for black tea. Thus the tea is steamed. The roaster raises the leaves every now and then a little above the surface and shakes them over the palm of his hand to separate them and disperse the steam (Plate VII, Fig. 23). When this is done the leaves are swept into a basket held in readiness by another man. The rolling and kneading are done in precisely the same manner as in preparing black tea. After they have been sufficiently twisted in the hands the leaves are spread out on sieves and allowed to cool for a little while, but the sooner they are put through the second roasting process the better. For this operation the fire is considerably diminished, charcoal being used in place of wood; but the kuo is yet kept so hot that the finger cannot touch it for more than a second, and great attention is paid to the regulation of the heat, a man being constantly employed to attend the fire, while another fans the leaves throughout the entire process (Plate VII, Fig. 24). The roaster agitates the leaves in the kuo until from loss of moisture they show no longer any tendency to uncurl. They are now of a dark-olive color, and after being removed and sifted are again (but now in larger quantity) put into the roasting-vessel, which is heated more moderately. In this last roasting a peculiar change of color takes place; the leaves becoming covered with a bluish tint resembling the bloom on fruit, which is the distinct character of this species of tea. Until this coloring (which is the only proof that the leaves are thoroughly dry) there is no rest allowed the workmen. The three roastings occupy about ten hours, the original quantity, 33 pounds, requiring the entire attention of one man. The crude product of these roastings is called Mao Tsha, and, when not assorted on the spot, is sent to Canton, where it is passed through different sieves and winnowed by tossing on large bamboo trays (Plate VII, Fig. 25), and at last is passed through a winnowing-machine like that used for separating chaff from wheat. It is now assorted into four principal classes known as *Hyson*, *Hyson-skin*, *Young Hyson*, and *Gunpowder*. Previous to packing, these are mixed according to the quality required.

Singlo or *Twankay* tea is prepared in the same way, only with less care than the Hyson. The operation of rolling is often performed with the feet as a relief to the hands, and the Twankay kuo resembles that used for black tea, except that it is placed obliquely at an angle of 16° on the stove and about 9 inches below the surface (Plate VIII, Fig. 26). This tea is often roasted only twice, then sifted and assorted in the same manner as Hyson.

Experiments upon the difference of color in black and green tea have proven that the tint depends entirely upon manipulation and not upon heat. With the same degree of heat the same leaves will be black if allowed to remain quiet during the last roasting, while they become green if kept in an incessant state of motion; the former management tending to retard, while the latter accelerates the evaporation of the juices, which is further augmented by the fanning.

In India the process of manufacturing tea is far simpler and less expensive than the methods employed in China and Japan. Mr. James L. Forbes, a Pennsylvanian, now managing a tea factory in Eastern Ben-

gal, and who has written quite an interesting and instructive article on the cultivation and manufacture of tea in that country, says:

The leaves are carried from the gardens direct to the rolling-house, and are there scattered over the floors and allowed to cool, two men turning them over occasionally. They are then scattered on mats and allowed to wither till they are quite soft and pliable; they are then taken in, placed on shelves, and are ready for rolling next morning. The rolling-house is generally a large building, over 100 feet long and some 40 feet wide, with tables running the whole length. The coolies form lines on each side of the tables, facing each other, and about two feet apart. Twenty pounds of leaf are placed between every two men, who, placing their hands upon it, spread it out, and roll it backward and forward, from right to left, all keeping time in their movements and stimulating each other by yells, shouts, and contortions of the body, that would make a stranger imagine they were in the greatest torture. After half an hour's rolling the batch of leaves is taken and passed through large sieves, where the leaf is separated into fine and coarse qualities, and then taken back to the tables, where it is rolled separately till finished. It is then pressed into balls of about one pound each, and placed in rows on a table for fermentation, which takes place in about one hour's time, great care being required not to over-ferment the leaf, which would spoil the tea. When the fermentation is complete, the tea changes from dark green to a salmon color. It is now taken in baskets to the firing-house. This is a large building, with about fifty fire-places ranged round the side of the walls, about three feet high, and looking very much like the fire-holes in a brick-kiln. On top of the brick-work are frames with slides, each fire-place having four drawers. The three upper ones have bamboo nettings for bottoms, with a mesh of about eight to the inch; the lower one has a bottom of zinc. Each cooly has charge of three fire-places or twelve trays. He pulls out No. 1, breaks up the ball of tea, and spreads it lightly over No. 2. He now fills No. 3 on top of No. 2 and and No. 4 on top of No. 3, and then presses them all in over the fire of glowing charcoal below, taking care to keep the zinc tray below, in order to catch any of the tea that might fall while pressing in the upper trays. He now pulls out the lower tray, No. 1, and allows the heat to pass through the tea, changing the trays from upper to lower, thus drying off each batch of tea. This is about the hardest work in the factory on account of the great heat.

The sorting of the tea is done with sieves made of galvanized wire of five different sizes, Nos. 8, 10, 12, 14, and 16. They are about 6 feet long by 2 feet wide, and are suspended about 4 feet from the ground. They are set in motion by a cooly pushing them backward and forward. The tea is first passed through No. 8, a man standing at the side of the sieve and crushing the tea with his hands. This is much the best way, as rubbing it against the wire gives it a gray color and rubs off all the bloom. The tea remaining in No. 8 is the fourth quality, called Souchong. What has passed through No. 8 is put through No. 10, all remaining in that sieve being third quality, Pekoe Souchong. Again, the remainder is passed through No. 12, and gives us second quality, Pekoe; and once more it is passed through No. 14 to get the first quality, Broken Pekoe. No. 16 is used for taking out the dust and cleaning the fine teas.

The teas are now carefully picked over by women, who take out all stalks and other impurities, and, after being heated over just sufficient to remove any existing dampness, are packed in bins made of zinc, capable of containing 5,000 pounds each.

From the description of Mr. Forbes, it is quite evident that the East Indian processes of manufacturing tea are far less complicated, irksome, and expensive than the old methods of China and Japan. And that these Assam and Cachar processes will in time become, through the introduction of further improved machinery, more generally adopted we have abundant reason to believe. Already much has been done in this direction. Mr. Bonsall, for a number of years connected with tea-plantations in East India, has described in a former report some of this machinery, which it may not be out of place to reproduce here:

Pl. VIII, Fig. 27 is a winnowing-machine, with movable divisions, which separate the interior into four or five troughs. The tea is placed in the hopper above, and the handle is turned with the right hand, while with the left the quantity of tea is regulated that shall fall through the hopper by drawing a slide at the bottom of it; the blast of the fan blows the dust and small particles of tea to the end of the machine, where it is intercepted by a board and falls through an opening (*a*) at the bottom into a basket placed to receive it. The next lightest tea is blown not quite so far, and falls out through the trough (*b*) on the side. This tea is called Pekoe; the next, being a little heavier, falls at the next trough (*c*), and is called Broken Pekoe. The next, being still heavier, falls through the trough *d*, is the Souchong; the heaviest falls through the trough (*e*) close to the pan, and is the coarse Souchong, also called Gun-

Plate I.

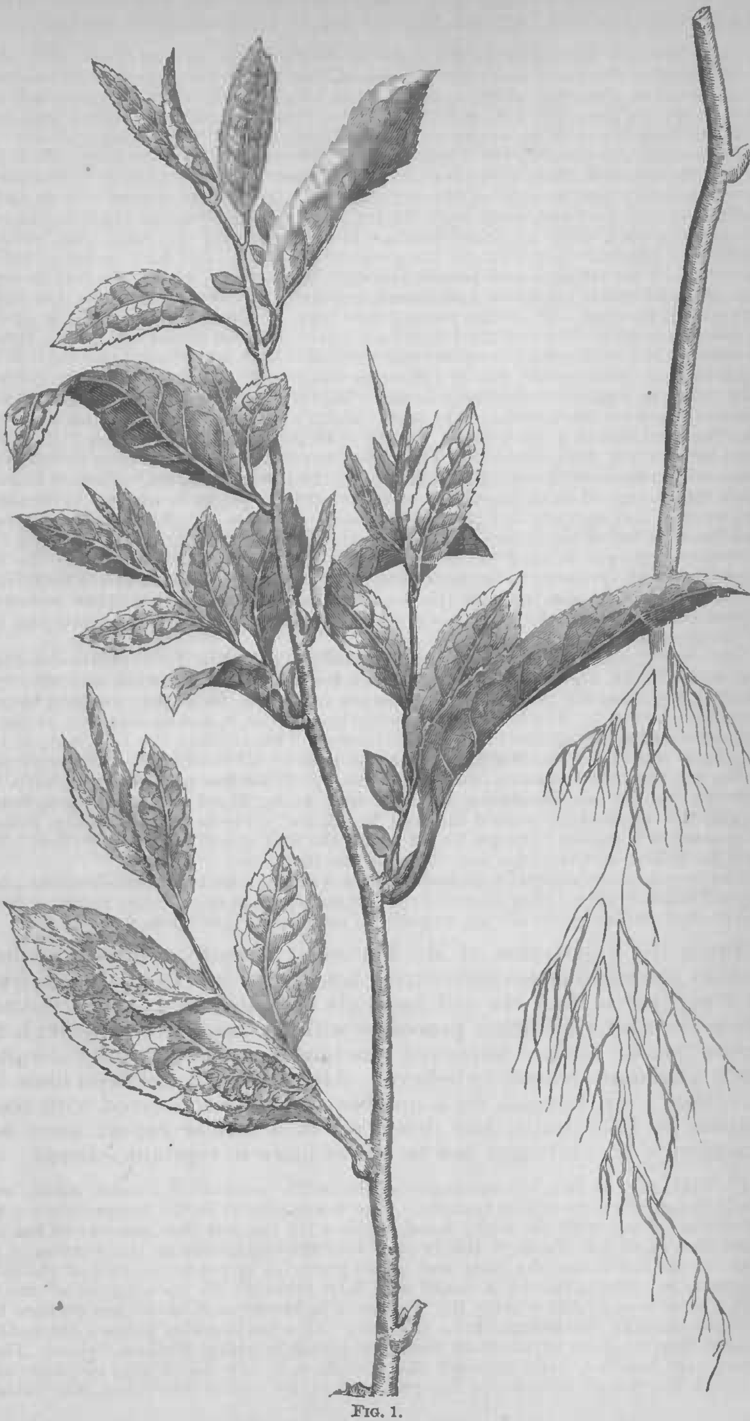


FIG. 1.

Plate II.

FIG. 4

Plate III.

Fig. 2.

Fig. 3.

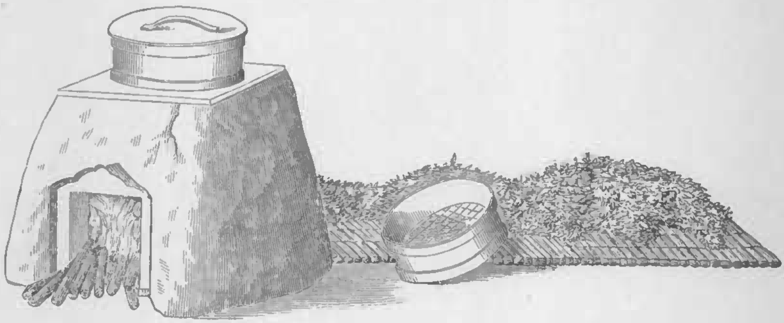


Fig. 5.

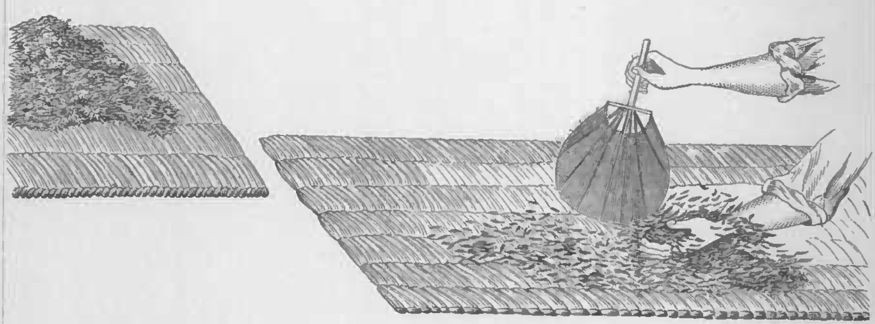


Fig. 6.

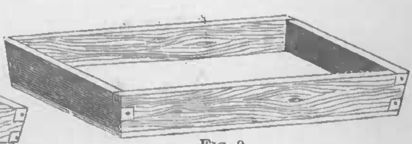


Fig. 9.

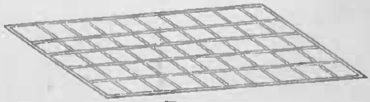


Fig. 8.

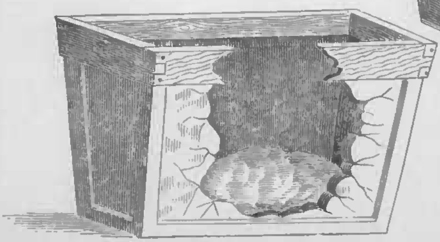


Fig. 7.

Plate IV.

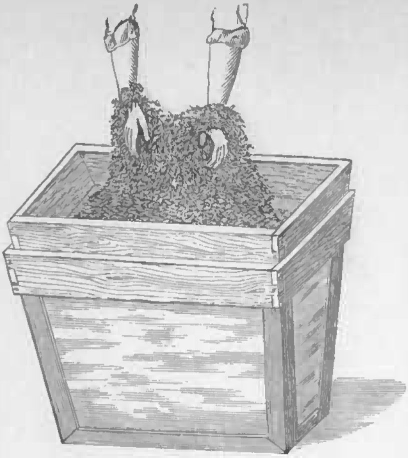


Fig. 10.

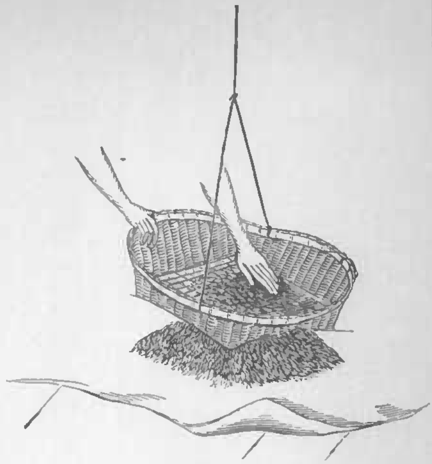


Fig. 11.

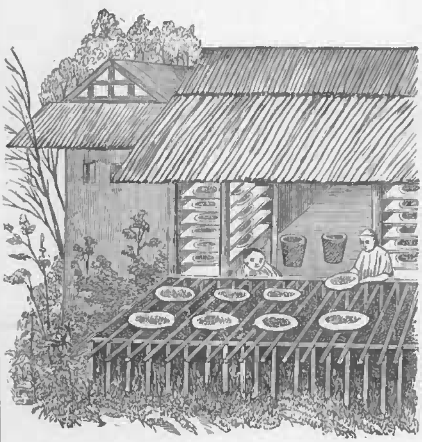


Fig. 13.

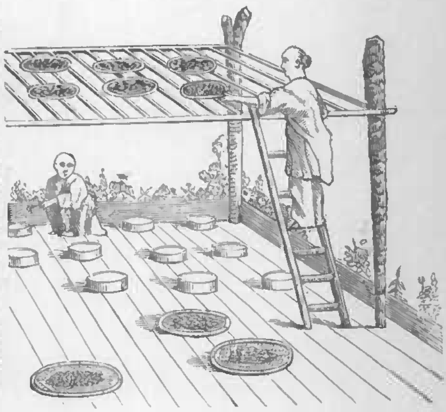


Fig. 14.

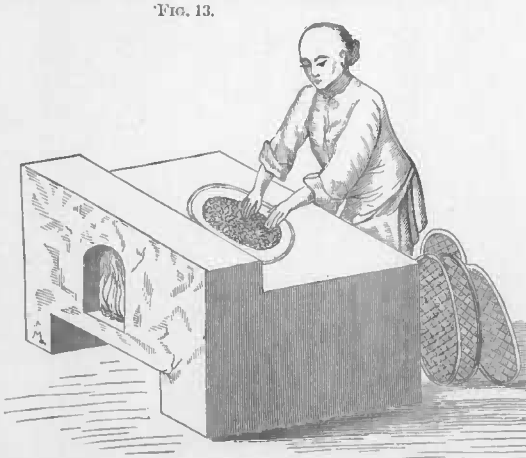


Fig. 17.

Fig. 15.

Plate V.

FIG. 12.

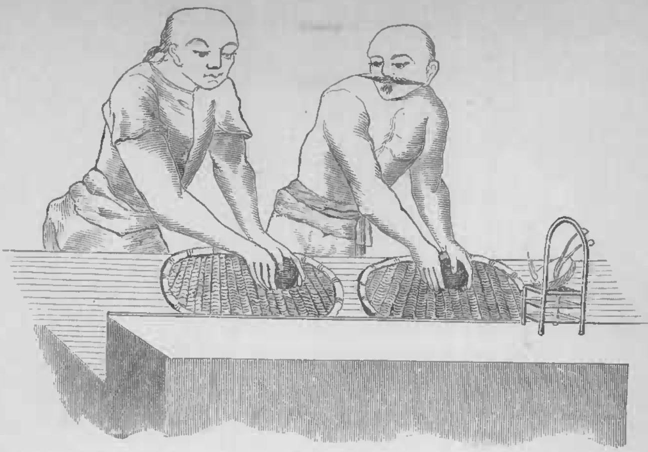


FIG. 18.

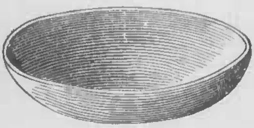


FIG. 16.

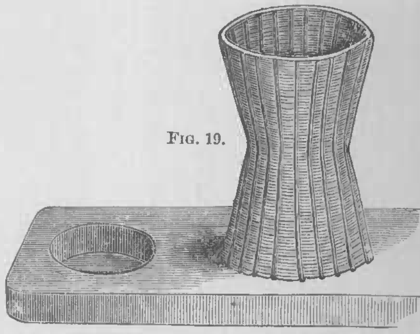


FIG. 19.

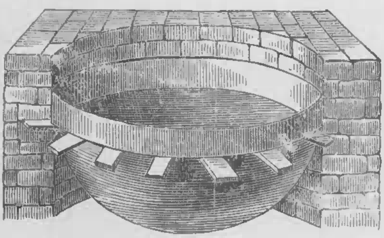


FIG. 22.

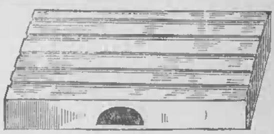


FIG. 20.

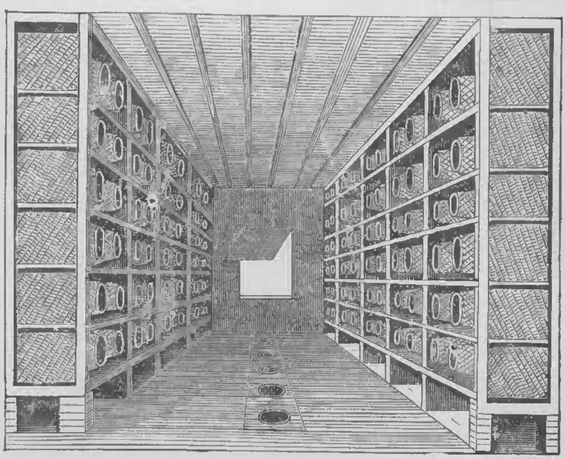


FIG. 21.

Plate VII.

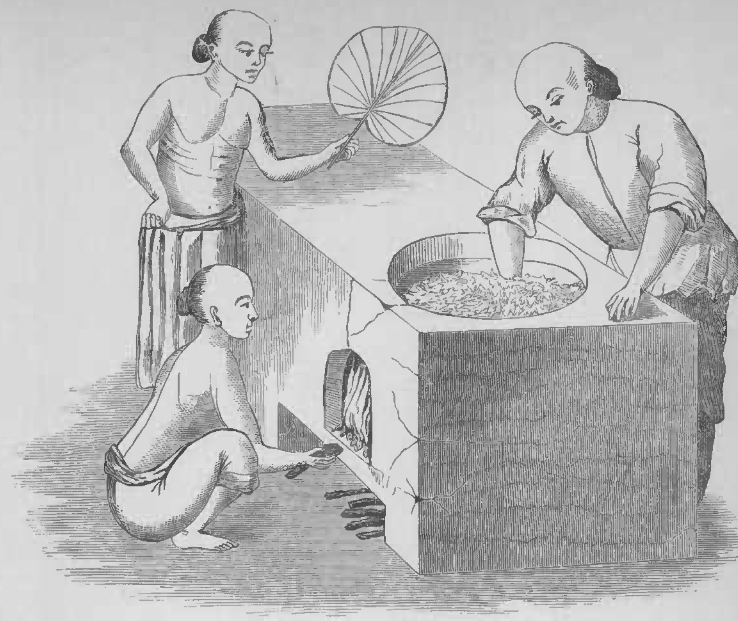


Fig. 24.

Fig. 25.

Fig. 23.

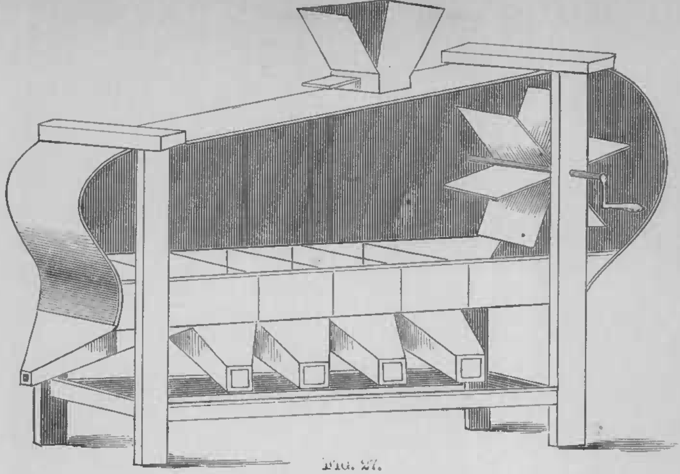


FIG. 27.

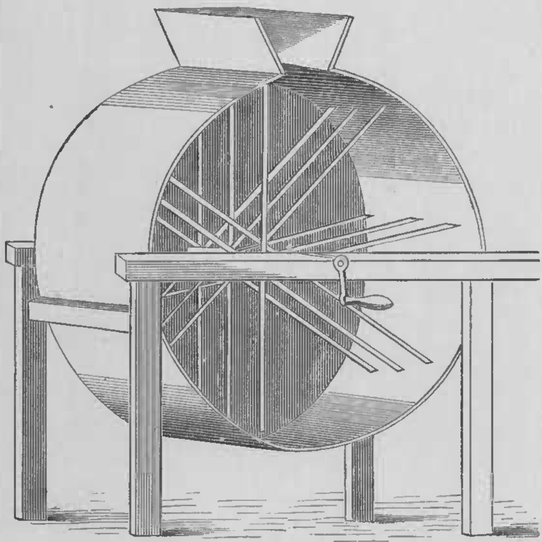


FIG. 28.

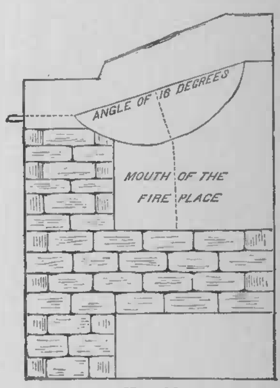


FIG. 26.

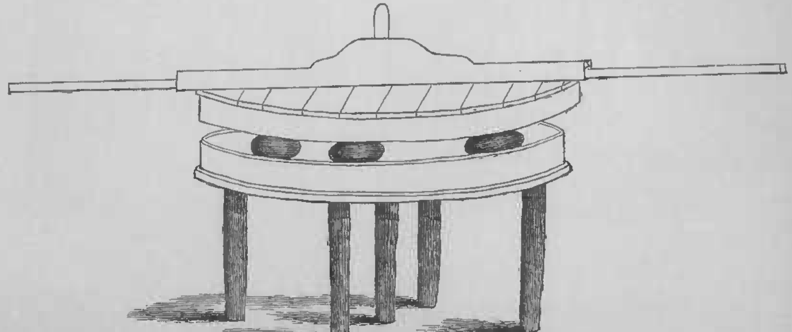


FIG. 29.

Plate IX.

Fig. 30.

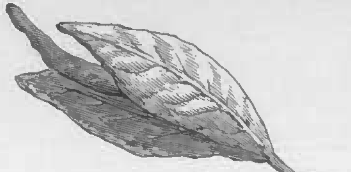


Fig. 31.

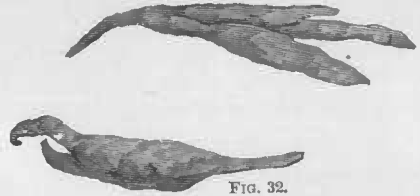


Fig. 32.

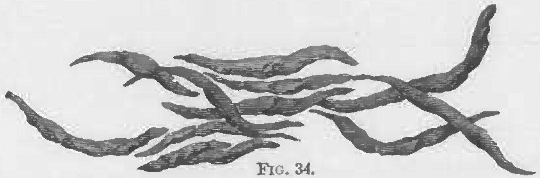


Fig. 34.

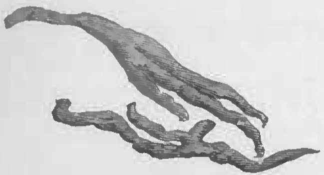


Fig. 33.

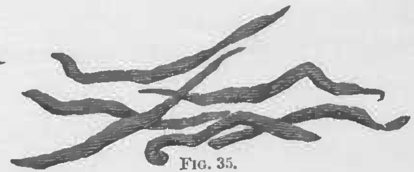


Fig. 35.

Fig. 36.

Fig. 37.

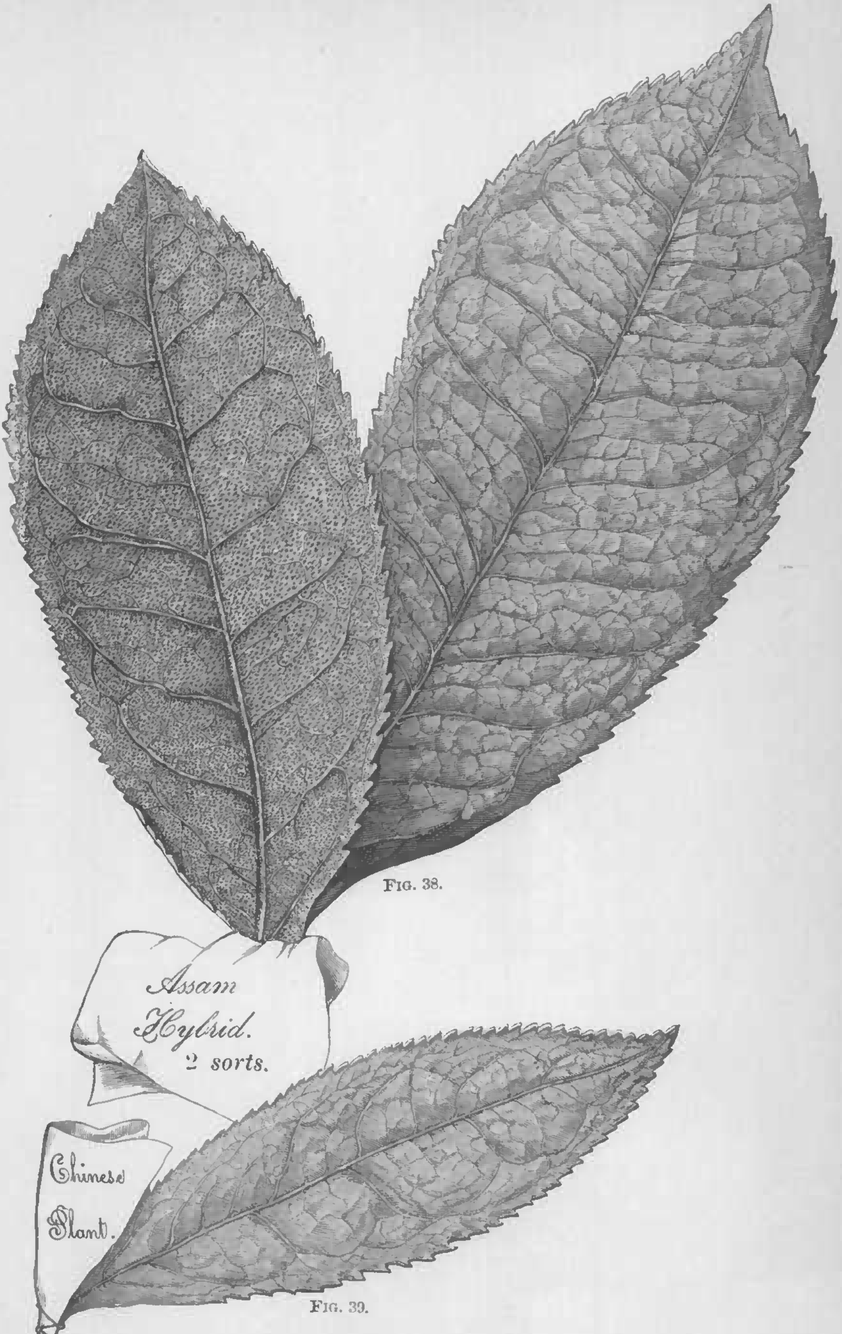


FIG. 38.

FIG. 39.

powder. This last kind is chopped up in a box with a sharp instrument and mixed with the Souchong of *d*.

Pl. VIII, Fig. 28. This represents a machine for beating the leaves, as it is considered that the flavor of tea is improved by beating the leaves after they have been withered in the sun, until a peculiar scent, somewhat similar to new-mown hay, is produced.

For rolling the tea-leaves into balls there is used a machine which answers the purpose admirably (Plate VIII, Fig. 29).

The markets of East India, especially in the districts of Assam and Cachar, are furnished with a very fine black tea, known in Europe as Assam or Indian tea. It has not as yet been brought to our American markets. This tea has some great advantages over the others, as it is not adulterated, and maintains a constant high flavor and uniform color and quality, owing to the more scientific management and the introduction of European machinery; and, more than all, to the fact that the large areas planted enable the well-organized and enterprising companies controlling them to manipulate large quantities of leaves at one and the same time, and to subject the entire mass to one and the same process; while in China and Japan the tea-growers, working only a little patch of land, manufacture the leaf in their own rude way, always making a distinction between what they make for home consumption and that intended for exportation. When the small cultivator has a sufficient quantity, he takes it to the nearest market-town, where it is disposed of to middle-men, who sell it to native merchants in the larger towns. These last assort, flavor, and "doctor" it, and then forward it to the seaports, where it is sold to European merchants at auction.

There are many other interesting facts connected with the general history of tea, and with its cultivation, manufacture, and characteristics as found in China, Japan, and the British East India possessions, mention of which we are compelled for want of space to omit. Enough has, perhaps, been said for an intelligent understanding of the different methods there employed, and for inducing such a wise modification of them to the industry as it shall hereafter be pursued in the United States, as the slightly-differing conditions of soil, climate, and the widely variant ones of labor may suggest.

It is gratifying to know that large portions of our territory present, with respect to climate and soil, corresponding degrees of latitude, and other circumstances, an open way to the introduction and culture of tea, and to believe that our people have sufficient enterprise to lead to its extensive manufacture.

The latitudes in which tea is successfully cultivated in China, Assam, and Japan correspond geographically with the latitudes embraced in the States of Delaware, Maryland, Virginia, West Virginia, North Carolina, South Carolina, Georgia, Alabama, Tennessee, Kentucky, Arkansas, Missouri, and a portion of the Pacific coast, and the conditions of temperature, soil, &c., are about the same. Wilmington, in Delaware, is parallel with Peking, one of the finest tea-growing districts in China; and the upper portions of South Carolina are parallel with three of the most abundant of its tea-growing provinces. So with the other States mentioned.

The successful experiments in its culture already made in several of the States above mentioned, and which are referred to in the letters hereto annexed, would seem to justify the opinion that, while tea-growing on a large scale and as a separate business, in this country, may not at present prove remunerative, in the absence of the large means which, coupled with persistent and untiring effort, have brought such marked success to the operations of European capitalists in Assam and else-

where, yet as a *home industry*, furnishing light, pleasant, and profitable employment to the wives and children of the farmers of certain sections of our country, it will, at no distant day, become an industry of great value.

The possibility that the tea-leaf may be cured and prepared by modern means and appliances rather than by the tedious hand-processes that we have described, promises sufficiently well to induce the necessary experiments; for, if successful, the expensive part of preparing would be done away with, and, as an industry, tea-producing would be placed in comparative advance, as was cotton by the gin and sugar by the centrifugal pan.

Moreover, the crop is one which will not interfere with any other. It would take in no way from the general work of the farm or plantation, but, on the contrary, be mere recreation, coming as a change and a new variety of occupation. Any family of three or four persons can easily cultivate a single acre, and can take care of it with little more work than is often given to pickling and preserving. And as in the domestic or family pickling and preserving it is not claimed that the pickles and preserves are made in small quantities at as low prices as it can be afforded by factories specially devoted to such industry, yet the superiority of the article produced is generally vastly in favor of the family production. So the teas made in small gardens by the surplus family labor has the advantage of superiority and classification, or separation of grades, not now known to the imported article. So that, whether or not as a special crop, tea can become an industry among us, it is plain that there are thousands of families in at least one-half, if not two-thirds, of our land that may profitably grow a tea-garden, and can enjoy it as they do the orchard or the berry-patch, and have the agreeable experience of drinking a beverage, never yet known in this country, from a grade of tea worth in China and Japan from $5 to $14 per pound.

EXTRACTS FROM LETTERS FROM CULTIVATORS OF THE TEA-PLANT IN THE UNITED STATES.

Mr. J. J. LUCAS, Society Hill, S. C., says:

The tea-plant has been grown successfully in this State, Georgia, and Louisiana. Dr. Junius Smith, late of Greenville, S. C., planted it more extensively than any one else in this State. Dr. Thomas Smith, of this place, and General Gillespie, of Cheraw, obtained a few plants about the same time that Dr. Junius Smith did, but did not attempt to make tea. General Gillespie's plants are still living and thriving. On the Middleton place, Ashley River, near Charleston, tea-plants are now growing, for ornamental use only, and are ten feet high. A gentleman in Georgia (says the Rural Carolinian) obtained 441 pounds of tea from one acre of land, which, at 50 cents a pound, would bring $220.50. Our average cotton-yield is about $15 per acre; our best about $40.

It is recommended to plant 5 by 5 feet, or 1,764 plants to the acre. Mrs. R. J. Screven, of Liberty County, Georgia, says the tea-plant thrives as high up as Athens, and is more liable to injury from heat than cold. The editor of the Soil of the South, New Orleans, succeeded so well, that he was offered $1.50 per pound for his make of tea. Cotton is now in price below the cost of production, and we must try something else.

Dr. TURNER WILSON, Windsor, N. C., says:

I have been raising the tea since 1858, but without much cultivation. My yard and garden are sandy soil, and the plants or bushes, without any cultivation, are of slow growth. I plant the seed about the first of April, but they come up under the bushes very thick from the fallen seed. Sometimes I throw a little dirt on the seed which I do not pick up. I have several hundred plants under the bushes from 4 to 12 inches high, and about fifty in my front yard. The leaves may be picked in May, July, and September, the last any time before frost. The cost of picking would be a mere trifle, as one hand could pick two or three bushels a day.

JAMES H. RION, Esq., Winnsborough, S. C., says:

I live in Fairfield County, which is a little north of the center of the State. In the fall of 1859 I received from the Patent Office, Washington (of which the Agricultural Department is a part successor), a very tiny tea-plant, which I placed in my flower-garden as a curiosity. It has grown well, has always been free from any disease, has had full outdoor exposure, and attained its present height (5 feet 8 inches) in the year 1865. It is continually producing perfect seeds, which readily germinate and produce healthy seedlings. This shows that the plant finds itself entirely *at home* where it is growing. There cannot be the least doubt but that the tea-plant will flourish in South Carolina.

Mr. JAMES S. MURDOCK, Charleston, S. C., says:

I would also mention that the tea-plant is well suited to our climate. A gentleman at Georgetown, on our coast, writes me that he has raised a large number of plants from the seed, and they are as thrifty and grow as well as our wild orange, the cold weather which we have occasionally producing no effect on them.

Mr. ARTHUR P. FORD, Charleston, S. C., says:

About four or five years ago I obtained from a friend some seeds of the tea-plant, and planted them in my garden, twenty-one miles from Charleston, inland. The plants came up readily, were duly transplanted, and are now fine shrubs three feet high, and seven in number. The foliage is luxuriant, and the plants bear the coldest weather here without any ill effects, the mercury on more than one occasion marking 16°, and the plants being encased in ice at other times also.

I am satisfied that both tea and coffee plants would succeed in the South, and it would be well if our planters could be induced to experiment with both.

WILLIAM SUMMER, esq., Newberry County, S. C., says:

There are several healthy, vigorous tea-plants growing in Columbia; these plants have been cut back to keep them in proper condition in the grounds where planted. I have seen at the Greenville residence of the late Hon. J. R. Poinsett the tea-plants growing finely of those introduced by Dr. Junius Smith. And he remarked to me that we have here the *Olea fragran* (fragrant olive), with which we can flavor the tea equal to any prepared for the special use of the Emperor of China. The fragrant olive blooms freely from early spring until midwinter, and the flowers, when gathered fresh and put in the caddy among the tea, impart a delightful aroma to the tea. I have at different times imported a few tea-plants from Angers, France, and these have been disseminated from the Pomaria nurseries, and found to succeed. I have no doubt of the success of the tea-plant in the middle and upper portions of this State.

Mr. S. D. MORGAN, Nashville, Tenn., says:

The shrub grows luxuriantly in Central Georgia, even 100 miles north of Augusta, to my personal knowledge, as I there used the domestic article for several weeks' time and found it excellent. There may, however, be a difficulty about its culture for want of a very cheap class of laborers to pick and prepare the leaves. This, however, is a subject I have not investigated, but I think it is worthy of a thorough investigation.

Mrs. MARY J. IVES, Lake City, Fla., says:

Your letter making inquiries in regard to the tea-plant has been received.

My husband obtained the plants, through a friend, from the Department of Agriculture at Washington, in the year 1858. They were then small plants, only a few inches in height. Now they are large shrubs.

I have used the leaves for making tea, and those who have tasted it have pronounced it of a very fine flavor.

The plant is not at all affected by cold weather such as we have in this climate, blooms and bears seeds, and can be propagated by cuttings as well as by the seed.

Mr. ALEX. M. FORSTER, Georgetown, S. C., says:

My plants are in a rich, dry soil, and grow very rapidly, requiring only three or four years to reach the height of 4 feet. They are as thrifty and bear the vicissitudes of our climate as well as the native Cassina (*Ilex cassene*). I have several times picked (in April) a quantity of the young leaves, and commenced the process of curing them according to the directions given by Mr. Fortune (see Agricultural Report, 1853), but I have never had the perseverance to carry out fully the entire process. Yet I have made some fair black tea, better than much that is said to have come from China and for which I have paid $1.25 per pound.

Rev. A. MERIWETHER, Columbia, S. C., says:

I obtained a Chinese tea-plant from North Carolina nine years ago, and set it out in open ground in a plat of Bermuda grass. It has received no cultivation, and is now a

fine shrub, measuring to-day six and a half feet in height by nine feet across the branches at the base. The soil where it grows is light, sandy land, with no clay within two feet of the surface.

The plant is not affected by the severest cold to which our climate is subject. It was not the least injured by the intense cold of December, 1870, when my thermometer registered 1° above zero; the coldest weather I have ever known in this latitude.

My plant blooms from the latter part of August on to December, and makes a beautiful ornamental shrub. It is evergreen. I have obtained tea of the best quality from the cured leaves. The process of preparing the leaves for use is the same as that given in the Southern Cultivator, January number, 1872. There have been successful experiments made with this plant in Florida and in Georgia. That the climate of the Southern States is well suited to the cultivation of the tea-plant I think there can be no question. *I sincerely hope you may succeed in your efforts to arouse our people to the importance of its cultivation.* If only enough tea were made to supply the home demand, what an immense annual saving would result!

Mr. JAMES EDWARD CALHOUN, Trotter's Shoals, Savannah River, S. C., says:

Eighteen years ago some half-dozen tea-plants, brought from China, were sent me. I set them in a soil friable, of medium quality, unmanured. Nothing has been done beyond keeping down the weeds with the hoe. The plants have had no protection; but during a portion of the first summer seedlings have some shelter. As yet there has been no damage from blight or from insects. Frequently leaves are clipped in moderation from all parts of the bush, care being taken not to denude. They are parched in an iron vessel at the kitchen fire, constantly stirred, and immediately afterward packed in air-tight boxes. To prepare them for infusion, they are ground in a coffee-mill.

The capsules of the tea-nuts afford the most pleasant of bitters. They were saved and given to the matron, an item in her *materia medica* for my people, long before I heard that a physician in Georgia had carefully tested the "tea-hull," and found it to possess all the properties of the cinchona.

At the axil of every leaf there is a flower-bud; often two, sometimes three buds. They would be invaluable to the apiarian.

On the 12th of November frost stopped the blooming of cotton, but swarms of the honey-bee continued to visit the fresh blossoms of the tea-plants. This is the perfect climate for the tea-plant.

Mrs. R. J. SCREVEN, McIntosh, Liberty County, Ga., says:

My experience is that the tea-plant does best in land somewhat low, but not such as water will lie upon or is overflowed. I sow the seed in the fall, as soon as they ripen and drop from the bushes, in drills eighteen inches apart. They come up readily in the spring, and by winter are from three to six inches high. Under the shade of some large tree is usually the place selected for sowing the seed, for if the plants are exposed to the hot sun while young, they invariably die the first summer. When six months old they are ready for transplanting, have generally a good supply of roots, and can be set out at any time from the first of November to the last of March. In putting them out, I have generally prepared holes to receive them, to give a good start, so that fine, healthy bushes will be obtained.

The holes are usually dug out a foot or more deep, and equally as wide, and filled in with half-rotted leaves, a little cow-pen manure and surface soil; all of this to be packed down to prevent water settling around the plants whenever it rains. The tea is planted up to its first leaves, and a little water given to press the earth close to the roots. As soon as the warm spring weather begins each plant is shaded from the sun. A crutch, two feet out of the ground, is driven in on each side of the plant, a strong stick placed across the crutches, and pine branches leaning upon this make a cheap and good shade.

The tea, when young and not large enough to shade its own roots, is very sensitive to the heat of the sun. This shading being somewhat troublesome, I have adopted another plan. It is this: to set out the plants under the shade of some large bush or tree until they are about two feet high, then take them up carefully, cut off nearly all the tops, and plant out in their permanent places. As soon as spring opens they will put out sufficient leaves to shade their own roots. In April, 1867, I think it was, Mr. Howard, from Baltimore, who has been engaged on a plantation for several years in the East, visited my father's plantation in this county. He expressed himself as surprised at the splendid growth of the tea. Being there at the time of gathering the young leaves, he plucked from one bush alone, prepared the tea himself, and took it on to Baltimore, where he had it tested and weighed. He wrote back that it had been pronounced stronger and of superior flavor to the imported, and that by calculation he was satisfied that four hundred and fifty pounds of cured tea could be made here at the South to one acre of ground.

I have only prepared black tea, the process being very easy and simple.

The leaves are gathered the day before they are to be dried, and spread thinly over tables to wilt. The small leaves are cured by themselves, as they make the most superior quality of tea. The day after being plucked, they are taken in the hands and rubbed until they become soft and flaccid. They are then placed in heaps and allowed to remain so for about one hour. They are then put into a Dutch oven, which is heated by a few coals under it. While in the oven they are constantly stirred with the hand to prevent scorching. They are roasted five minutes, taken out, and rolled again upon the table. After being rolled, they are exposed in the open air in the sun, and frequently stirred. While these are out in the air another set is in the oven. When all have been roasted, those first put out in the air are brought in and roasted again for five minutes, then taken out and rolled again. They are now placed in a sieve about an inch thick and held over a few hot coals, stirring all the time. They are then taken out and rolled again. This process of rolling and toasting is continued until the tea assumes a dark color. After all the leaves have been treated thus, they are put in a basket and hung over a few coals and frequently stirred until the tea appears black and dry.

M. J. W. PEARCE, Fayetteville, N. C., says:

My plants are now about five feet high, and very thick and bushy near the ground, covering a space as large as a molasses-hogshead; have no protection from any kind of weather. The mercury has been as low as 10° below zero. They do not seem to suffer from drought, are evergreen, and bear a beautiful white flower with little scent until nearly ready to fall. The bees are very fond of the flowers. My plants have never suffered from insects of any kind. Half a dozen plants furnish my family of five or six persons with more tea than we can use. We prepare it by heating the leaves in an oven until wilted, then squeeze them by hand until a juice is expressed from them, then dry them again in the oven. The tea is then quite fragrant and ready for use. It improves by age. We pick the leaves about three times during the year.

MARTIN GILLET & Co., of Baltimore, Md., write as follows:

In response to your request to furnish you with information relating to teas and their preparation for market that our personal observation in China and Japan suggests as of value in connection with your efforts to introduce tea-culture into the United States, we beg to submit the following:

So great is the difference in appearance and character between green and black teas and their several flavors and varieties, it has always been a disputed question whether they were procured from the same plant. The following account of the principles governing the preparation of the several kinds of teas will plainly show, however, that all descriptions of teas are made from the same species of tea-plant, their differences resulting chiefly from the methods of treatment adopted. The facts herein stated are obtained from personal investigations in the tea-districts of China and Japan. Our object is to explain, in as simple a manner as possible, the conditions which govern the transformation of similar fresh leaves into the different kinds of teas, and which information we believe essential to the successful production of an American tea.

From the time the leaves are picked until finally prepared for consumption in the form of teas of commerce they all pass through two distinct processes. The first process is one of curing or drying the fresh leaves, and varies according to the kind of tea desired. The second process is simply firing or roasting, similar to that of coffee-roasting, after the cured leaf has passed through the first or curing process, and is the same in all cases. Hence it follows that we have to look simply to the method of curing adopted in the first process for those peculiar changes that cause such striking dissimilarities in character and flavors as are found in the different varieties of the commercial article.

In the first process there are three distinct methods of curing the fresh leaves, producing the three great classes of teas, viz., Green, Oolong, and Congou. The two latter are both black teas, and are prepared in China, while the green class includes the green teas of China and the entire crop of Japan. The largest market for green teas is the United States. The Oolong class, sometimes called by consumers black tea with a green flavor, is also largely used in the United States.

The Congou class, including Souchongs and English Breakfast, is almost exclusively used in England and Australia. A Chinaman may convert his crop into either of the three classes named, just as a planter of tobacco may prepare his leaves for either smoking or chewing purposes. It is found in China, however, that in certain districts the leaf is more profitably manufactured into a specific kind of tea, green or black, just as the tobacco crop of Connecticut is more advantageously used for smoking purposes alone. To this fact, doubtless, the prevailing impression may be attributed that, because one district always makes green or another black tea, the plants are different,

especially when the teas produced in either locality exhibit such marked differences in appearance and chemical characteristics.

To make it plain how these three classes come from the same leaf and owe their differences to chemical changes produced in curing, we will follow the history of the fresh leaf through each of the methods, three in number, referred to as the first process, till it is ready for the second or roasting process, which, as has been stated, is the same for all classes.

Taking each method in order, the first, producing the green class of tea, may be called the quick method. Its object is to cure the leaf with as little delay as possible, to prevent the slightest possible change in the color and chemical properties of the fresh leaves. In this method the fresh leaves, or only so many as can be cured by the afternoon, are dried in wicker baskets lined with paper, over a slow fire, or by any similar device. An illustration of the effects of the quick drying as preservative of color or quality is found in the familiar process of preparing green or autumn leaves or curing garden seeds. But little change beyond desiccation has been produced in leaves thus cured, and that property of inducing wakefulness is preserved in an eminent degree, both the green teas of China and those of Japan being noted for their exhilarating qualities. Teas of this class, after being thus cured, are much in the condition of green coffee, both having been dried. It has been stated that the original use of the word "green" as applied to tea was in the sense of fresh, and had no reference to color.

The second method of curing is much slower than that employed with the green class, and produces the second great class of teas—Oolong, or "black tea with a green flavor." There being no haste required in the drying, this is retarded by making piles of the fresh leaves, where they are allowed to wilt, a slight heating or sweating being induced. It is this sweating that changes the chemical nature of the leaves and produces flavors quite different from those developed in the green class. The infusion in boiling water has lost much of the astringent qualities so prominent in the green class, the power of producing wakefulness has been diminished, while the flavor is so altered as to constitute a distinct class.

Finally, there is the third method of curing, producing the third or Congou class, in which very radical changes are found. Here that strong chemical force fermentation is called into play, effecting marked and decided differences in every respect. The leaves when gathered are piled up and steamed or dampened in such a way as to induce fermentation, which is arrested at the desired point. This treatment, it will be observed, is similar to that adopted in the curing of the tobacco leaf, and the color of the pile of leaves is changed to a dark reddish-brown, almost exactly like that of tobacco. The chemical changes produced separate this class very widely from the previous classes. The properties that induce wakefulness are almost destroyed, the astringency is so lessened that nearly double the weight is used to make a cup of tea, and both the flavor and color of the infusion more resemble coffee than green or Oolong tea. In countries where this Congou class is largely used the consumption of coffee has fallen off rather than increased—as in England and Australia, where tea is a national beverage—and the consumption is confined almost exclusively to this Congou class.

Thus is the tea crop of the world divided into three separate classes, whose distinctions are due neither to soil, climate, nor leaf, but to the treatment the leaf receives in the curing. We do not wish it to be understood that peculiar effects are not due to both soil and climate, but we have called attention to those marked chemical changes which, according to their several degrees, create three great and distinct classes, and which are described as—

Green Tea—dried by the quick method, the chemical changes in which are very slight.

Oolong—the slower method—sweating without fermentation; considerable chemical changes.

Congou—produced by fermentation of the leaf; in this method radical chemical changes in the leaf.

After the leaf has passed through one of the above methods it is ready for the last or second process, which was stated to be the same for all kinds, and consists of simply firing or roasting the leaf. This can be done in open pans, its object being to do exactly what we accomplish when we roast coffee.

With three methods to choose from, the question will be asked, Which produces the best kind of tea? But a little reflection will show how impossible it is to correctly answer this question. It is a matter of taste and fancy, and in localities where one method may fail another may succeed. It is only after intelligent experiment that a successful result will be reached.

We have purposely omitted all reference to the laborious manipulation of twisting and rolling the leaf into the shapes of Gunpowder, Imperial, Hyson, &c., as immaterial, the natural shape of all tea being the same. These conventional forms and the artificial coloring of green teas, which people have so long considered as an essential part

of good tea, we ignore entirely, and would impress on all the importance of producing a tea solely to drink and not to look at. Strange as it may seem, China green teas are valued in our markets quite as much for their appearance as for their drinking qualities.

The abandonment of all unnecessary and expensive manipulation and the deleterious system of coloring the natural products to suit the demand of uninformed purchasers, in connection with the diffusion of correct information in regard to the principles and methods of preparing the leaves for consumption, will, in our judgment, accomplish all that is required to reward your efforts to introduce, with entire success, the production of tea upon American soil.

The following extracts from a letter from Mr. M. I. Saunders, Debrugurh, Upper Assam, India, received since the preparation of the foregoing article, will doubtless prove interesting in connection with the general subject of tea-culture and tea-manufacture:

SIR: I take the liberty of addressing you on the subject of your report No. 3, on the practicability of cultivating and manufacturing tea in the United States.

* * * * * * *

I have been engaged in tea culture and its manufacture since 1864, and am at present the manager of private estates producing 125,000 pounds annually. * * * From my knowledge of the wants of the tea-plant, I conclude, after reading your report, that there should be no difficulty in successfully introducing it into many parts of the United States. * * * * *

The inclosed leaves show the Assam Indigenous (Pl. X, Fig. 37), the Assam Hybrid (Pl. XI, Fig. 38), and the China (Pl. XI, Fig. 39), all in a dry and unrolled state. * *

Nearly all our teas are now made by machinery. Much of the cultivation, even, is done by a machine with which one man cultivates two acres per day.

THE OLIVE.

The department desires to call the attention of agriculturists in a large portion of the United States to the importance of the cultivation of the olive, a tree of great value on account of its fruit, the uses made of the wood, and the oil which is expressed from the fruit.

Attempts, here and there, have been made to cultivate the olive in this country; but from various causes, none of which could be attributed to the conditions of the climate and soil, they were not successful to any great extent. The country was new, and farmers everywhere were not disposed to enter upon the trial of experiments with foreign plants which did not promise immediate or yearly results. The time has come, however, when agriculture is enabled to take a broader scope, and experience and observation teach a way and means to add to individual and national prosperity in the introduction of a variety of products needed by our people, suited to our climate and soil, and for which we have been dependent in the past upon other countries.

The Jesuits, it is related, introduced the olive into California more than a hundred and fifty years ago, and some of these trees are still standing and bearing fruit, though their cultivation has never been pursued in the way of a special industry. In 1755 a gentleman of Charleston, S. C., introduced the olive into that State; subsequently (1829) Mr. Robert Chisolm, of the same State, planted olive seeds, which produced trees that are still bearing. A colony of Greeks and Minorcans, who settled in Florida in 1769, brought the olive to add to the prolific plant production of that semi-tropical State. In 1817 Congress appropriated a grant of lands, in the present State of Alabama, to a company of French emigrants, for the purpose and on the condition of their introducing and cultivating the olive and the grape; but the enterprise was not successfully prosecuted, and finally failed, and the lands reverted to the government.

Thomas Jefferson, an advanced agriculturist of his day, indulged the hope of introducing the olive into Virginia and other Southern States, and when in Paris, in 1787, wrote "that although the olive was the tree the least known in America, it was the most worthy of being known," and pronounced it "of all the gifts of Heaven to man, next to the most precious;" and further adds: "Having been myself an eye-witness to the blessings which this tree sheds on the poor, I never had my wishes so kindled for the introduction of any article of new culture into our own country."

The fruit of the olive is preserved by pickling. In this form it is esteemed a great table delicacy, and in Europe constitutes an important article of food for the people.

The wood of the olive, especially the root part, is beautifully clouded and veined, has an agreeable odor, and is susceptible of the highest polish. It is greatly prized for these reasons by cabinet-makers, by whom it is wrought into their finest work. It was of this wood, so hard and lasting and of such fine grain, that the Greeks sculptured their divinities before marble and ivory came into use.

The oil, unlike most other vegetable oils which are made from the seeds of plants, is contained in the pericarp or the flesh of the fruit, and is carefully extracted from it before the seed is pressed. This is known as salad-oil. It is an inodorous, pale, greenish-yellow fluid, with a bland, oleaginous taste, unctuous to the touch, inflammable, incapable of combining with water, and nearly insoluble in alcohol. It is the lightest of all fixed oils.

In other countries this oil enters largely into the domestic economy of every family. With us it is only used as a condiment, but its essential importance is in its use in the arts and manufactures. It is also used in medicine, and is particularly valuable in the manufacture of woolens. Castile and other fine soaps are made of olive-oil mixed with alkalies. As it becomes viscid more slowly than any other vegetable oil, it is especially valuable to watch-makers, and for the workings of all complex, delicate machinery.

Italy, Spain, France, Portugal, and Austria are the countries where the olive is most extensively cultivated, and where it constitutes a large portion of the wealth of the farmer, and from whence the United States and other countries receive their principal supplies. It is cultivated also to a considerable extent in Greece, Sicily, Morocco, Tripoli, Tunis, Algiers, Turkey, and Australia.

The finest oils for table use are said to be produced in Tuscany, whence they are shipped from Leghorn in various measures, from pipes of 110 gallons to the flask of oil, with its straw covering, weighing about 14 ounces. The Apulian oil, grown in Italy and shipped from Naples, is preferred by woolen manufacturers, by whom it is extensively used. The inferior oils are used in making soap. The oils of Sicily, like those of Tunis, are too thin to be used singly in the manufacture of soap, and, being used only for mixing, are less valuable than most others.

The importations of olive-oil to the United States amount to over 400,000 gallons annually, valued at more than half a million of dollars.

The countries which grow the olive for purposes of commerce present conditions of latitude, climate, and soil similar to a number of the Southern States and a portion of the Pacific coast. It is a hardier tree than the orange, and will endure a much colder climate. It will prosper even in barren soils, and requires but little attention in its culture.

The olive, botanically speaking *Olea Europæa*, was one of the plants brought into cultivation at a very early period of man's history, and con

siderable doubt now exists as to its native country. Some authors suppose it to have originally belonged to Western Asia, from whence it migrated into Southern Europe and Northern Africa, while others regard it as indigenous to both Europe and Asia. The tree seldom exceeds 20 feet in height, and has oblong or lance-shaped leaves, smooth upon the upper surface but hoary underneath, axillary, erect racemes of flowers, and pendulous ellipsoidal fruit. The fruit is a smooth, oval plum, about three-fourths of an inch in length and one-half inch in diameter, of a deep violet color when ripe, whitish and fleshy within, bitter and nauseous, but replete with a bland oil, covering an oblong, pointed, rough nut.

It is a branching, evergreen tree, of slow growth, very tenacious of life, and of great longevity; so great, indeed, that it is thought probable that the trees at present existing in the vale of Gethsemane are those which existed at the commencement of the Christian era.

In all ages the olive-tree has been held in high estimation. It is written that in early times a branch of it, borne to the Ark by the returning dove, signified to Noah that the waters on the face of the earth were subsiding. Among the Greeks and Romans wreaths of its leaves adorned the brows of conquerors, and it has ever been regarded as the symbol of peace. The value and usefulness of the olive, the little attention necessary to its culture, and the waste situations which it renders productive, should make it an object of special attention in a large portion of the United States.

In the East, where the olive is cultivated with success, the mean temperature of the year is between 58° and 66°; the temperature of the winter not being under 42° nor that of summer below 71°.

Its cultivation in Europe, however, where the olive enters largely into the industries of the people, and where it is found in perfection, extends as far north as latitude 44½°, showing that it endures considerable vicissitudes of cold and heat, and that in this country it could be cultivated successfully from latitude 35° north down to the Gulf of Mexico, embracing an area of ten or a dozen States.

Mr. P. L. Simmonds, an English author of several valuable works on agriculture, has furnished, perhaps, the most thorough information on the culture, &c., of the principal products of the vegetable kingdom. In the course of an exhaustive treatise on the subject of the olive, he states that in France and Italy the young olive bears fruit at two years old, that is, in two years after it has been placed in the plantation. In six years it begins to repay the expense of cultivation. After that period its products are the surest source of wealth to the farmer.

Soil which consists largely of lime is very favorable to the growth of the olive-tree. Situations near the sea are also favorable to it. The islands on the coast of Georgia and Florida, and the seaboard of North and South Carolina, are well suited to its cultivation. One of the great merits of the olive-tree, however, is that it will grow in almost any situation where there is not a redundancy of moisture, and in any kind of soil in a latitude congenial to it.

The olive-tree is propagated by sowing the seeds, from cuttings and graftings which grow easily and readily, and from little swellings or knobs called *uovoli*, which are excrescences upon the bark containing embryo buds. *Uovoli* is a Tuscan word, and means little eggs. These are similar to bulbs, because they are capable of producing new plants. They are carefully separated from the trunk and planted in the ground where it is intended they should remain. The tree is not very productive until it is six years old, when it produces valuable crops. From this period it yields very abundantly for many years, even until a great age

after the trunk has become hollow. In the south of France, and in Italy, there are olive groves which are said to be 700 years old, and which are still productive.

In making a plantation the plants should be set out in rows, about the same distance apart as are the trees in an apple orchard.

Like most other trees that have been cultivated for a length of time, the olive has produced numerous varieties, different countries and even different districts cultivating their peculiar favorites. The variety known as *longifolia* (long leaf) and its many varieties are chiefly cultivated in France, Italy, and Austria. The variety *latifolia* (broad leaf) and its subvarieties are those chiefly cultivated in Spain. By distinct names there are five kinds whose cultivation receives particular attention, viz., *Verdall*, which yields fine oil and makes a good conserve; *Blanquet*, with a particularly sweet and delicate oil (these two have low-growing branches, which enable them to be picked by hand); *Bouquettier*, a very superior oil; *Redouanou*, which stands cold well; *Olivier de Grasse* yields excellent oil, but grows high, and is not so well adapted to picking.

The olives of the above-named varieties are propagated in various ways. Cuttings of 9 inches in length, taken from one-year-old shoots, may be planted in a rich light soil and kept moderately moistened. The ground ought never to be allowed to become very dry. Under such conditions the cuttings will root freely in a few weeks, and be fit for transplanting in twelve months. They are propagated also from seed. In Italy propagation is conducted in the same manner in which it was during the time of the Romans; that is, from little swellings or knobs called *uovoli*, heretofore described.

In Spain the olive forms a very considerable product of its agriculture, and large tracts of land are planted in olive groves.

The harvest of the olive begins when they are scarcely ripe. The green olives are put in a solution of salt, where they are kept for some time to cause them to lose their natural bitter taste. They are then carefully preserved in vinegar, mixed with different spices, and sold in bottles or small barrels. In all parts of Southern Europe they are, in this form, a daily food.

The treatment of the ripe olive is more important. They are gathered in the fall, when they are as large as common plums. Their color is then a dark green, and the kernel has changed into a hard stone, which contains a savory almond. The flesh is spongy, and its little cells are filled with mild oil, which pours out at the least pressure.

The proper season for gathering the olives for the press is the eve of their maturity, which varies in different climates and in different varieties, but which is easily distinguished by the color of the fruit. The quantity of the oil, it may be mentioned, depends upon gathering the fruit in the first stage of its maturity. If possible the harvest should be completed in a day.

The best manner of collecting the fruit is by hand, though there are two other modes. One is by shaking and the other by beating the tree with slender poles, but both are injurious. The shaking harms the roots and the beating breaks the young shoots and branches.

The olive-tree, in full bearing, yields on an average from two to three bushels of fruit, which would produce from fifteen to twenty pounds of oil. Properly planted, an acre of land should contain about one hundred olive trees. Grasses and other crops may be cultivated between the trees to advantage, and it is a good plan to fold sheep in the olive orchard. Olive-oil may be said to form the cream and butter of those countries in which it is pressed. There is a common saying in Italy that

"If you want to leave a lasting inheritance to your children's children, plant an olive."

A simple method of pickling olives while green and in a full-grown state, as practiced in France and othes countries, is as follows: For each pound of olives take a pound of good strong ashes (those from hickory wood are the best) and an ounce of good slaked lime; mix the lime and ashes with water until a soft mortar is formed, into which stir or imbed the olives, and finish by covering the whole mass with a layer of dry ashes. Let them remain in this state until all the bitumen is extracted, which may be known by the stones slipping readily out of the pulp when squeezed between the forefinger and thumb, for which purpose a few may be tried once an hour or oftener if desired. The length of time required for this, however, will depend entirely upon the quality of the ashes and lime, and may consequently vary from two or three hours to a day or two. As soon as the olives have been deprived of their bitter ness, they must be cleanly washed and put to soak in fresh water, which must be changed about once an hour for twenty-four hours, when the taste of potash will be removed and the water ceases to be discolored. The olives must then be put into bottles or jars, and a strong brine put over them made from good rock or alum salt. This brine will generally require to be changed several times in consequence of becoming ash-colored; after which the bottle must be sealed air-tight, and if kept in a cool, dry, dark place the olives will keep for years. Olives carefully prepared after this plan will be found very palatable and delicate, and will retain much of the nutty flavor of pure olive oil. In their preparation coriander, cloves, cinnamon, and such aromatics as are desired may be added to the brine.

Such of the prepared or pickled olives as are destined for the tables of the luxurious are taken out of the brine after a certain time, deprived of the stones, in place of which is substituted a caper, anchovy, or a bit of truffle, and closed up in bottles of the finest oil. In this manner they are kept palatable for two or three years.

In some countries, to give the prepared olive a deeper green color, an admixture of copper is used; therefore those of a fawn color should always be preferred in the selection.

The oil is obtained by a simple process. The freshly-gathered olives (the ripe fruit) are put into little heaps, and by their own weight the oil is pressed out and is caught in some vessel placed to receive it. The pulp of the fully ripe fruit contains a very large per cent. of oil. When the fruit ceases to give the oil in this way, by themselves, they are crushed in a mill of very simple construction, when the workmen remove the pulp, put it into coarse sacks, and subject it to a very gentle pressure.

The first oil extracted and used for culinary purposes is of the purest quality, and is called virgin salad-oil. The pulp is next thrown into boiling water from the surface of which the oil is skimmed. Even after this second process a certain quantity is left in the refuse. Being of an inferior sort it is used only in making the coarser soaps, plasters, &c. There is still another quality of oil obtained by moistening this residuum, breaking the stones, then boiling and again pressing it. This is used for burning purposes, in lamps, &c. Of the refuse, at last, formed into cakes by the pressure in extracting the oil, a good fuel is made, which burns steadily and gives a good light. From the ashes of this a potash is made. After the oil has been drawn it deposits a white, fibrous, and albuminous matter, but when this deposition has taken place it undergoes no further alteration, and is ready for bottling. The utmost cleanliness is necessary in making the oil. With the nicest economy in the

process, which is finished in a day, it amounts in weight to nearly one-third of the fruit. The mean produce of the tree may be assumed in France at ten pounds, and in Italy at fifteen, but single trees have been known, in a good season, to yield eight or ten times that quantity.

The oil-mill retains nearly its primitive form, and consists of a basin raised two feet from the ground, with an upright beam in the middle, around which a massive millstone is turned by water or by a beast of burden. The press is solidly constructed of wood or of cast-iron, and is moved by a compound lever.

Gallipoli, in Italy, supplies large quantities of oil to foreign countries, and is celebrated for its fine purified oils. It is clarified to the highest degree by keeping it in cisterns hollowed out of the rock on which the town is built. When shipped, it is put into well-constructed casks, the staves of which, before they are put together, are well soaked in sea-water. In this condition it will perform long voyages in the heat of the summer, without waste or leakage.

The olives of which the Gallipoli oil is made are never gathered from the trees, but allowed to drop in their maturity on the ground, where they are picked up, chiefly by women and children, and carried to the mill.

Aix, in France, is also celebrated for its olive groves and the manufacture of superior qualities of oil.

Olive oils are classed into table or edible oil, refined oil, manufacturing oil, and burning oil. The first or salad oil is divided into fine, superfine, and ordinary.

The Italians keep their oil in stone jars. The oil for sale is filled into barrels made of oak staves imported from Germany.

The treatment of oil resembles somewhat that of wine. By a long rest dregs will settle at the bottom, which must be removed or the oil would become rancid, therefore the barrels are tapped every six months and filled anew. Oils of a finer quality can seldom be left more than three years.

The process of refining oil is as follows: Large shallow tin boxes are made with small holes pierced in the bottom, which is then covered with a thin sheet of wadding. Four, five, or more of these boxes are placed on frames, one over the other, and the oil, being poured into the top box, is allowed to soak through the wadding and drop into the next box, and so on until it gets into the last, when it runs off into the tanks. The wadding retains all the thick particles contained in the oil when it comes from the mill, and leaves it perfectly clear.

Mr. Robert Chisolm, of Charleston, S. C., writing under recent date in regard to his experience in the cultivation of the olive, says:

I procured my trees from the neighborhood of Florence, Italy, through the American consul there, with whom I was acquainted, while I was traveling in 1828 and 1829. I received two varieties, one for stocks and the other for scions, to bear the fruit for oil-making. Both varieties bear, and equally abundantly in my soil, but the variety sent for stocks bore fruit which, although larger than that borne by the variety for making oil, yet it was inferior in quality, and did not even make as good pickled olives, but as I did not know the difference between them, both were propagated equally as long as I continued to increase my trees, which I did until I had between 250 and 500 trees, many of which are still alive and growing, and well, as well as could reasonably be expected from the repeated burnings of the land by the negroes just after the war, when they took possession, and since my return the little attention that I could give them. Before the war it was my practice to manure the grove every spring and plant it either in sweet-potato slips (layers of the vine), or "cow" or "clay" pease, and then the trees bore most abundantly and regularly every year, almost to the breaking down of large branches. The normal habit of the olive tree, like that of most other fruit trees under ordinary treatment, neglect to bear a full crop one year, and the next year rest and recruit. The soil of my plantation was a rather stiff clay loam, in

which pears throve admirably and bore only too well, while peaches, grapes, and apples did not thrive. Some years ago I made a little oil and exhibited it at the fair of the South Carolina Institute, and was awarded a premium for it, but as the gathering of the olives had to be done just at the most busy season of a planter's year, I never gathered any crop. I was a large cotton-planter and such a small business would not pay, as labor was limited and needed for more profitable employment. However, I always gathered enough to pickle for family use and to make presents to my friends.

The following is the recipe by which I have always pickled my olives, and for which I have received several premiums (the same as found elsewhere in this paper, derived from Mr. Chisolm).

The main reason why I never made my olive crop into oil was that I could not, in this country, get bags that could stand the pressure necessary to extract the oil. Canvas could not stand, neither Dundee bagging, as I tried both and failed.

In Europe bags or sacks called "cabas d'esparlerie," as I read, are the only ones that are used, and I never could procure any in this country.

I had a cotton-seed-hulling machine and a powerful press, but being unable to procure the necessary bags to stand the pressure, could do nothing.

Olives are eaten greedily by cattle, sheep, hogs, and poultry, and for feeding any of the above stock it would pay handsomely to cultivate the trees. Poultry proved to be very fond of the olives while steeping for pickling, and for several winters I kept a small stock of hogs in fine order upon the ripe olives daily shaken down for them, and yet they are, when ripe, about as bitter as quinine.

I have cultivated successfully the Capers plant (*Capparis spinora*), making annually four bottles to each plant, with no more trouble than gathering the buds and dropping them in a bottle of vinegar at hand. The plant endures our climate perfectly, with the precaution of covering each plant in the autumn with a bushel (more or less) of long manure.

The truffles can be cultivated in this country, and could hardly fail to prove a very lucrative small industry, as it is suited to very poor, sandy lands, and only requires the cultivation of a certain variety of the oak (the *Quercus pubes*) for its production. The truffles are worth $4 per pound in the markets of Paris.

Mr. Frank A. Kimball, of California, in writing of the cultivation of the olive in that State, says:

That this tree is wonderfully productive for one so long lived is evidenced by the fact that Mr. Thomas Davis gathered 192 gallons of fruit from one tree, which netted him over $150 (in 1873, at Mission San Diego). This orchard is now under control of the Catholic Mission, and is entirely uncared for. In the spring of 1872 I procured some limbs from this orchard and cut them into pieces about 12 inches long, and on the 9th of May set them out. In the fall of 1876 I picked five gallons of olives from one of the trees, and in 1877 I gathered about 12 gallons from the same tree, the row of eleven trees averaging about six gallons each, which would bring $1 per gallon to-day at wholesale. In April of 1875 I bought cuttings for five acres, and set them out during that and the following month. None of them started till August. (The cuttings were taken from the trees in January and lay exposed till April.) The following February one of the trees bloomed, and in October, fourteen months from the time the first leaf put out, I gathered one ripe olive. The succeeding February it bloomed, and in October last some of the fruit was ripe and still ungathered. Over fifty of the trees bloomed, but I allowed only two to bear fruit. I have cultivated these trees as follows: Cuttings were watered four times the first year, six gallons per tree each time; next season four times, with quantity increased to ten gallons; and in the past season four times, increasing the quantity to about fifteen gallons. After each watering I stir the ground around the trees, usually with a garden rake. My trees, some twenty-five acres, are set out at an average distance of 24 feet each way. I hope to add twenty acres this year, believing, as I do, that at three years old they will pay an income, and at five years old will produce from three to five hundred gallons of fruit per acre. The wholesale price of San Diego olives has never been less than 80 cents per gallon. Our market is the world.

Mr. H. S. Kedney, Maitland, Orange County, Florida, writes:

The olive grows as luxuriantly in Florida as in its native lands. There are groves of immense olive trees in portions of this State which are annually loaded with fruit. This fruit is of the poorest variety of the olive, as I know, having paid particular attention to the olives grown near Oporto, in Spain.

Orange County, from its altitude, as compared with most other counties of the State, is particularly suited to the growth of the olive. The only objection to their culture is the time required to bring the fruit to perfection, but the dwarf olives of Oporto commence to bear in three or four years from the scion, and produce large fruit of superior quality.

SHIPMENTS OF FRESH MEAT TO EUROPE.

The month of October, 1875, records an important era in the development of the resources of this country. It was then that the shipments of fresh meat as a business was begun. A few live cattle had been sent to foreign markets before this period, and a few have crossed the ocean since, but as this mode of shipment is very expensive on account of the large space required, and as it also embodies a heavy shrinkage in the condition of the animal, it can never assume such proportions as will make it an object of material interest. As ocean freights are charged by the space occupied instead of by the actual weight, 40 cubic feet being reckoned a ton, a more compact form of shipment was a necessity. The high price of meat on the other side of the Atlantic proved such an incentive to Yankee genius, that two processes have been invented and are now in successful operation for preserving meat fresh while in transit, and delivering it in good order for consumption in the markets of the Old World. As these processes were fully described in the Report of the Department one year ago, they need not be repeated here.

Mr. Timothy C. Eastman, the pioneer shipper of fresh meat to Europe, has forwarded to Liverpool and London during the past year (from January to January) 26,333 carcasses of cattle, 14,929 of mutton, 200 of pigs, and 45 of veal; to Glasgow, Scotland, 13,666 carcasses of beef, 5,567 of mutton, and 13 of veal; to Havre, France, 261 carcasses of beef. The shipments to France have just begun and the demand is therefore limited, but is slowly increasing. Mr. Eastman has increased his shipments over 1876. His lowest shipment in any one week (and this was during the hottest weather in summer) was 300, and the highest in one week was 1,500; this was in winter. During the summer the refrigerators are used extensively for the transportation. His shipments for the last week in January, 1878, were 1,520 cattle and 1,200 sheep. He intends to increase his business during the coming year, and has added five steamers on the National Line and two French steamers to the number on which his refrigerators are placed. He does not send as much to Glasgow as formerly, as the market there was overdone. The market on the continent is as yet an experiment, and embodies the necessity of creating a more general habit among the people of eating more meat, and a taste and a demand for American beef and mutton. In Great Britain it was only necessary to overcome the prejudice against the American product, and the demand naturally increased. In Great Britain the future consumption of American meat is only a question of ability to buy on the part of the people of that country. The process of cooling and caring for the meat has not been changed, but a few improvements have been made in the construction of the refrigerators and in the placing of the meat. The hooks are now adjusted so that the quarters hang sufficiently separate to allow the cool air to circulate freely between them, and to swing with the motion of the ship without rubbing against each other. The doors of the refrigerators now shut on rubber jaws to make them tight, and the air-tubes which convey the air from the ice are made much larger, and with round instead of square corners, to enable the currents of air driven by the jaws to pass through them with more force and rapidity. The ice boxes have better drainage, allowing the water from the melted ice to escape more freely, thereby reducing the tendency to melt.

The best cattle are most in demand, and Mr. Eastman ships none but the heaviest animals. He has an agent in Chicago who selects his cat-

tle in that market, and ships them direct to the yards of the New York Central and Hudson River Railroads, located at West Fifty-ninth street, New York, where they are slaughtered, and where extensive refrigerators have been constructed to keep and prepare the beef before transferring to the refrigerators on the steamers. A large force of men are here employed in killing the animals and preparing the carcasses for shipment, and in packing the hides and rendering the tallow. Mr. Eastman has received as many as fifty car-loads of cattle in one day. The average weight of the cattle sent abroad is 800 pounds. They range from 650 to 950 pounds when dressed. A few extra cattle have dressed as high as 1,300 pounds. The weight of the carcasses of mutton has averaged 68 pounds. They have varied all the way from 60 to 80 pounds. No large hogs are sent—only what are termed "block hogs," which can be cut up and sold fresh to good advantage. Their average weight is 120 pounds. Fresh pork does not keep well, and a small quantity only is required to fill the demand. The largest proportion of beeves shipped will weigh from 800 to 850 pounds net. These fat and heavy steers are scarce, and are gathered from all over the West. The best ones come from Kentucky, where they attain these desirable proportions feeding on the blue-grass which grows to such perfection in that State. Two hundred and fifty cattle a week are sent forward from Kentucky for this special market. One-third of his whole shipment comes from Illinois, where they are fattened. Many of them however are bred farther west. Iowa furnishes about one-sixth, Missouri about one-fourth, Kansas about one-fourth, and Nebraska about one-eighth. A few come from the far west—from the grassy valleys of the Rocky Mountains. No Texas cattle are ever sent to a foreign market, as they are too light in the quarters. High graded short-horns or meaty natives are preferred, and are the most profitable. The latter are bred in the various parts of the Western States, and are descended from the native cattle taken by the early settlers from the East. As is well known the native cattle of the older States are a mixture of the blood of the various breeds brought originally from Europe. From Colorado and the Territories a good class of cattle now come forward, which are crosses of short-horn bulls upon the Texas and Cherokee cows. The latter are black, and black and white, and are generally larger than the Texas cattle, and have been bred among these Indians so long that they have become established as a distinct breed; they are descended from the cattle brought over by the French. The Texas cattle introduced from Spain are mostly yellow, fawn, and light-red. The crosses upon these two breeds are a decided improvement upon the original types, and some of them have been sent abroad. A second cross would improve them much more by thickening the quarters and the loins, thus making them more desirable.

The margin for profit in the foreign shipment of fresh meat is very close. Beef is not so high at this time as it was last year. The largest proportion of the beef shipped abroad is worth, in the New York market, 9 to 10 cents per pound by the carcass. The same beef on the other side of the Atlantic brings from 5½ to 6½ pence—11 to 13 cents per pound. The market on the other side is liable to be glutted with meat, at which time the prices are forced down to a much lower figure. This was the case during the holiday weeks, owing to the influx of poultry and holiday animals, which so ran the market down in price that the American meat landed at this time was sold at a mere nominal price, causing a heavy loss to the shippers.

The sales of Mr. Eastman have averaged during the year about 5¾ pence, equal to 11½ cents. The English market is exceedingly fluctuat-

ing, hence the risks in shipments are increased. The actual cost of shipment, including bagging the quarters (each quarter being sewed up in a sack), ice, freight, and commissions for selling, is about three cents a pound. If a dollar a head could be made on each beef it would be a satisfactory and paying profit. A quarter of a cent per pound is a good profit. With this small margin only the shipment of large numbers will make it a paying business, and then only upon the basis that all the appliances must be of decidedly a thorough and systematic character, backed up by the most economical management.

One-half of the sheep shipped by Mr. Eastman are from Kentucky. About one-quarter are fattened in the western part of New York, having been bred in Ohio and Michigan. These two States also furnish the balance of the sheep, where they are both bred and fattened; in blood they are a cross of Merino, Cotswold, and Leicester. The Downs sell the highest in Europe, but this valuable blood has not been generally disseminated in America, on account doubtless of the fact that the wool is light and low-priced, and the American farmer, except in very few instances, has not yet learned to appreciate a breed of sheep with their mutton qualities as the most important basis for profit. The Downs are the best for this purpose, because they mature early and have the plumpest loins and the thickest backs. The most preferable carcass to ship is one weighing not less than eighty pounds. This would carry the live animal up to one hundred and fifty pounds. Heavier sheep than this do not sell well, as there is too much fat in proportion to the muscle. Next in quality to the Downs for a mutton sheep are the Cotswolds. They are not equal to them in the rapid growth and maturity of the carcass, but the wool, being long and lustrous, sells at a much higher price. The offspring of Merino ewes, gotten by Southdown rams, makes a good mutton sheep; but when a further cross is made either by a Southdown, a Shropshire, or an Oxfordshire down, the size would be increased and a better mutton sheep produced. A dash of Merino blood in a coarse-wooled sheep begets hardiness and a better ability to stand the storms and sudden changes incident to our fitful and severe climate. There is a compactness of form in the Merino, and closeness and thickness of the fleece, which is valuable to engraft upon the coarser and looser-wooled breeds. A portion of Merino blood of at least one-fourth is essential in the sheep for the great plains; and here the American shepherd can multiply his flocks so cheaply that he may defy the competition of the world. Mutton will bear transshipment equally well if not better than beef. With a suitable article, adapted to the wants of the shipper and the demands of his customers, the market can be extended to such proportions as undoubtedly to keep pace with the improved flocks which may be multiplied to an almost unlimited extent in the great pastoral regions of the United States, which are specially designed for sheep-grazing.

Mr. Eastman does not intend to ship to Germany this year, as he considers France a sufficient field to develop for the present. It costs $2.50 more to send a carcass of beef to Hamburg than to London or Liverpool, and as the price there is but 6 to 7 pence per pound, the margin for profit is not proportionately widened. What makes the initiation of the enterprise more undesirable is the fact that, notwithstanding these adverse circumstances, the German steamship lines and dealers on the other side insist that the American shippers shall run all the risks, without any guarantee for sales or paying prices. This is too much of a test even for American enterprise, and with this outlook no beef shipments will be made to Germany, at least for several years to come. In Havre the city authorities charge one-half cent per pound dues, and the government

one cent per pound, on all the meat sold, for the privilege of selling. If this onerous tax should be removed it would, of itself, make a profit entirely satisfactory to shippers, and enable them more successfully to compete in a limited market. At the present time Germany is shipping live cattle to England, and is a competitor with the American producer.

Messrs. Sherman & Gillette have reduced their shipments very largely from what they were at the close of 1876. During the year 1877 they reduced their shipments fully 50 per cent. below what they were at the beginning of the year. On account of this great reduction they have taken their refrigerators entirely out of the Cunard line, and also out of the ships of the National and Bristol lines. Their shipments are now confined to the Inman steamers. The shipments were stopped in the summer on the above lines, and during the fall the contracts were annulled. During the summer months their shipments were light and scattering. The week ending January 28, 1878, they sent forward by the Inman steamer 176 cattle, 100 sheep, and 190 hogs. They ship the same quality of beef as Mr. Eastman, ranging in weight from seven to eight hundred and fifty pounds, fully one-half equaling the heavier weight. Now and then a consignment of cattle is made running up to one thousand pounds and over. They aim to have sheep average seventy pounds, and they range from sixty to eighty pounds. Pigs average one hundred and thirty pounds. Their slaughter-pens and cooling-refrigerators are located at Harsimus Cove, Jersey City, at the termination of the Pennsylvania and Erie railroads. A majority of their cattle are fed in Illinois; some come from Kansas and some from Nebraska. One hundred in all of their last year's shipments were driven from Colorado; and 10 per cent. of the whole (and these among the best) came from the valley of the Shennandoah, in Virginia. Twenty-five per cent. of their sheep came from Canada, while New York State furnished as many more. The balance were mostly from Ohio. Mr. Gillette does not think that American beef has averaged more than 5 pence (10 cents) per pound in the English markets during the past year. They have not changed their process of preserving the meat, but have widened the space between the walls of the refrigerators, as they found that the sides of the steamers, being of iron, became so hot during warm weather that the heat penetrated through the compartments and affected the temperature of the meat-boxes. Salt and ice are still used, and the brine formed in the reservoirs is pumped through pipes around the meat the same as formerly. The hooks, however, have been changed to prevent the meat from rubbing and bruising. They do not intend to increase their shipments during the present year above what they are now doing.

Messrs. Soffey & Co. are also located at Harsimus Cove, and ship about one hundred cattle per week. They will not increase their trade, but will decrease during the coming year. The shipments from Harsimus Cove have fallen off largely from what they were at this time last year. There are only three firms shipping fresh meat by steamers from New York, to-wit, Timothy C. Eastman & Co., Messrs. Sherman & Gillette, and Daniel Soffey & Co. Messrs. Snowden & McConville and Samuels & Co., shippers last year, have stopped altogether, and their meat-boxes have been removed from the steamers. Messrs. Stahlnecker & Co., a firm which began the business in 1877, have likewise suspended shipping for the present, and may not send any more. When in the business they used two refrigerators. Messrs. Allerton & Co., in Philadelphia, have likewise ceased operations, and Messrs. Martin, Fuller & Co. have reduced their business to an occasional shipment. The above parties are the only ones at present engaged in shipping fresh meat from

America, except occasionally a few live steers are sent out by the Glasgow lines. The beef supplies are gradually changing farther west. Kansas and Nebraska now furnish a liberal quota and Colorado a considerable per cent. of the best beef coming to the seaboard. One consignment from Oregon has reached New York. They were big, bony cattle, and were driven southward to the nearest point on the California and Oregon Railroad, from whence they were shipped by rail to New York. They each lost two hundred and fifty pounds by their long journey. The ordinary shrinkage in transportation from the fattening-grounds to the slaughter-pens is an average of one hundred pounds to every steer. The average amount of beef for one hundred pounds of gross weight in fair to good cattle is from fifty-seven to sixty pounds. In extra stock from sixty-three to sixty-six. With light cattle the shrinkage is greater, and the net amount of beef is not more than fifty-five to fifty-six pounds per hundred of gross weight. The latter is the largest proportion of cattle usually sold in Eastern markets. With a larger rate of shrinkage in light cattle and a less price per pound, it is evident that it would be wisdom to raise and fatten a larger and improved breed. The sooner the farmers of the West appreciate this fact and adopt it the sooner will there be a more satisfactory return from their stock. Let it be remembered that pure Texas cattle sell on an average of 3 cents a pound less than the better sorts. All of the cattle sent forward this winter weigh less than they would if the feeding season had been more propitious. The wet, muddy weather which has prevailed in all of the feeding sections has operated to reduce the growth, and butchers estimate the loss on this account to be fully equal to one hundred pounds on an average on each steer. This reduces the aggregate amount of beef many thousands of pounds every week, and has had a tendency to increase the price.

With better times in England the demand for American meats would increase in a satisfactory manner, probably in a ratio equal to the increase in production, which will enable shippers to obtain their supplies on such a basis that they can afford to slaughter and send forward and compete successfully with the foreign article. A plentiful supply of good meat is a most important factor in this trade; and the most economical conversion of the grass and corn which abound on the plains and in the valleys of the West into meat is the great problem to be solved by the grazier and farmer. Competition will keep transportation down to the lowest cost. Sixty cents per hundred gross weight are charged for carrying a bullock from Chicago to New York, and 65 cents from Saint Louis, with about 20 cents additional from Kansas City. This is the price by the car-load, and a car-load must not weigh over twenty thousand pounds. Fifteen cattle, at an average of fourteen hundred pounds each, can be put into one car. From these rates it will be seen that the smaller the cattle the greater number can be put into a car, and the transportation will cost less per head; but, as will be shown in another portion of this paper, the other expenses per head are equally as great for small as for large cattle, hence there is no actual gain in shipping any bullock of light weight, but a decided loss. Eighteen thousand pounds is rated, with two decks, to be a car-load of hogs. Five hundred thousand cattle were received in New York by railroad during the year 1877, and of this number ninety-one were dead, being less than one in five thousand. One million cattle were received by rail in Chicago. Of this number four hundred and ninety-three were dead, being about two and one-half a steer in five thousand. The reason for this large difference in mortality is because the shipments to New York are made by weight not to ex-

ceed twenty thousand pounds to a car, whereas the cattle are sent to Chicago by the car-load, as many being put into a car as the shipper can crowd in. This overloading accounts for the difference. Live-stock are undoubtedly now transported in the most economical manner, so far as cost is concerned, and if they were unloaded, fed, and watered oftener, say at least once in twenty-four hours without regard to the distance traveled, and allowed to rest in comfortable quarters for at least five hours, the claims of humanity would be satisfied and all the necessary sanitary conditions complied with. The provisions of law requiring them to be unloaded at certain stated points, regardless of the time consumed in reaching those points, does not meet the case. The improvements in the car, making provision for feeding and watering in transit, will undoubtedly increase the cost of transportation, which is one of the things to be avoided if possible. Frequent yarding and feeding would also enhance the price of transportation, but this could be materially reduced by more rapid time, and then the shrinkage would be less. When under motion the cattle would suffer but little injury from a high rate of speed, as it is the starting and the backing which knocks them about. As long as so many thousands are unemployed in Great Britain, the price of meats will rule low, and more meat with less cost is the only remedy which, on this side, will help the enterprising shippers of the country to keep up the trade, unless they do it at a severe loss. American beef in good order, costing here not less than 10 cents a pound, with the expense of transportation to be added, has been sold on a glutted market in London and Liverpool for less than 4 pence (8 cents) per pound. This would entail an actual loss of 5 cents a pound, or $40 to a bullock. American pork comes into direct competition with beef and mutton, and where it has been made into bacon, the favorite form for the English market, it has an additional advantage in not requiring a hasty sale. This sort of American meat sells at retail, in London, at 7 pence (14 cents) per pound, while a pound of beef costs, retail, 8 to 9 pence (16 and 18 cents) per pound. Every economical housewife knows that a pound of bacon boiled will make a potful of cabbage, potatoes, and turnips, savory and palatable, and so feed a large family, while a pound of beef will count not much more than a small piece for a half dozen.

Raising cattle is a copartnership business. The grower has one share and the other must go to those who take the bullock off his hands, carry him to market, and slaughter and sell him. The largest item of expense is the transportation, as has been shown. While *en route* to market he is generally the property of the drover, who has purchased him from the grower, and who is the second factor in this trade. The drover looks after him while on the road, and sells him the first opportunity, provided he can make a fair profit. If no such opportunity occurs the bullock goes on to the seaboard, where he must leave the car and go into a yard. He has already had this experience and had the cost charged to his account two or three times. This yarding costs 40 cents a head. If the cattle are not sold immediately, and must remain overnight, feed must be bought at a high price. The next operator who appears on the ground to make his profit and livelihood out of the cattle is the wholesale butcher, who purchases at the yards and either slaughters there or transports the animal by barge at an additional cost of 40 cents to his own slaughtering establishment, from whence the quarters of beef, if designed for domestic consumption, are sent to Washington market, to be sold by a commission merchant at 5 per cent. commission. The retail dealer then carries them to his stall or shop, where they are cut up and sold by the piece to the consumer. So the grower has one share of the bullock

for his part, and the consumer pays for that and the other share which is divided among the others. It is a close business; the drovers not averaging more than $1 a head for their net profits, and the wholesale butchers realizing from $2 to $3 as their share of gain, with a heavy expense to come out of it, viz: the use of a large capital, buildings and appliances, and the cost of killing. The seller gets 5 per cent. with all risks of debts, &c., and the retailer cuts his meat and figures to sell at 10 per cent. increase on the cost. It costs now in New York $40 to transport a hundred cattle from the railroad termini to the private slaughter-houses, as they all have to go by barges on the water; whereas they were formerly driven across the city on foot at an expense not exceeding $2. This is required by local law. There is but little probability of reducing the various expenses connected with the trade in fresh meat, unless it be possible to get rid of the speculative drover, whose fitful profits really average but little. He seems, after all, to be a necessity, as breeders are not used to the transit, dislike its risks, and will probably continue to sell to the drovers rather than to send forward their stock on their own account. Many cattle are sold by brokers at the yards, who charge a commission on their sales. This is an extra tax on the beeves, which the consumer pays. Cattle sent to Europe are purchased at the yards by the shippers, who select and slaughter their stock on the ground, and thus avoid some of the extra expenses which follow stock which are designed for home consumption. The wholesale butcher, in order to make his profit of $2 or $3 per head, turns every part of the animal to account. Every thing possible is saved and sold for cash. The retail dealer must cut his profit out of one-third of the beef. If the balance can be made to bring cost he is satisfied. When the carcass costs 9 cents a pound he must sell one-third in roasts and steaks at an average of 18 cents per pound. One-fourth of a sheep can be cut into chops, which must be sold at 18 cents and the legs of the hindquarters for 15 cents, to make an advance of 10 per cent. on the cost at 8 cents per pound by the carcass, as the balance of the sheep will not sell for more than 5 cents per pound. The profits to a retail dealer on a beef weighing six and one-half hundred pounds would be less than $6, and on a sheep weighing fifty pounds the advance would be but 40 cents. A steer can be raised on the plains of Kansas and Nebraska and fitted for market at three years of age for $25 actual cost, and delivered in New York for $40 total expense; this is just about one-half of what he will bring in the market if he has been well-bred and fattened. Mutton can be produced at proportionate rates of cost and shipment per one hundred pounds. These figures give a margin for a paying profit to all concerned in the production and handling of fresh meat within the bounds of this country.

In regard to the shipping of American beef and mutton to Europe, this grand enterprise can be made a success and an enduring certainty in the future, if the farmers and graziers of this country will sufficiently extend and improve the business of growing cattle and sheep, as they possess advantages which the English farmers do not and cannot have. The latter, to a large extent, pay an annual rental for the use of the lands they occupy, equal acre per acre, to the actual cash value of half of the improved farms in the States of Iowa, Nebraska, Kansas, and Texas. These farms will average seventy-five bushels of corn per acre, which, for fattening properties, are equal to all that can be raised on the same quantity of land by the English farmer. The cost of the land and ocean transportation must be charged to the account of the American farmer in this competition, and then he will have the advantage. The

seventy-five bushels of corn can be produced at less than half the cost of the crop of the English farmer, notwithstanding he has the advantage of reduced price of labor, for the American crop is raised with a large reduction in the amount of labor. Already the foreign grower of beef is beginning to demand lower rents, as he sees he cannot pay the old rentals and compete with the American producer. It is plain that American enterprise will not only reduce the price of fresh meats in Europe, but also the value of agricultural lands. In the above argument we have assumed that the cattle and sheep were all grown and fattened on the improved farms of the States mentioned. In the great States of Ohio, Illinois, Wisconsin, Indiana, Kentucky, and Missouri the average value of farms is higher, but still the advantages in growing food and fattening meat are so much superior to those of the foreign farmer, that these States alone could successfully compete with them. When we come to consider the vast areas of pasturages which are available without any cost for the land until settled upon, only requiring the capital necessary to purchase the stock, and raised at a trifling cost and then shipped to the States where they can be fattened and sent forward to the sea-board as they are required, the actual cost of producing American meat is reduced to so low a figure that neither the British nor the continental farmers can compete. One man can plow, plant, and care for eighty acres of corn in one season. With the gang-plow, the horse-planter, and the two-horse cultivator in use in the great corn districts, a boy can do it. With a more perfected system in the breeding of stock, and greater economy in their fattening and handling, and a united effort on the part of producer and shipper to perfect a system in the production and exportation which shall be mutual in its benefits so far as is possible, there is without doubt, notwithstanding some of the present discouraging features, untold wealth to be gathered from her plains and prairies of the West, and healthful employment for thousands in pastoral life. To insure these results, the breeding of Texas and Cherokee steers should be abandoned as soon as possible, and the more quiet and thicker-meated short-horns, Herefords, or Holsteins, or their crosses, should take their place. These cattle will sell anywhere, and bring the highest prices, while the others will not pay for shipping abroad, and must be disposed of at a reduced rate at home. Here is an improvement which can be made at the very foundation of this business, and one which will add millions of dollars in the aggregate to the value of the beef production of the country. The same argument applies to the growth of mutton, which may be enhanced in a proportionate value by crossing the breeding ewes upon the most improved mutton stock. Such a system will not only add to the value of the mutton sent to market, but by improving the character of the meat help to create a demand for this most healthy of foods, which should be a leading staple for American families, but now stands second to beef and pork. After selecting an improved bull as the progenitor of the stock, the next step is to consider if a larger weight cannot be obtained during the three or four years of growth before the steers are consigned to the drover. If by a more careful handling and manipulation of feed this profitable result can be obtained, then the breeder has added largely to his profits and produced a standard of cattle which will, if properly fattened, insure the highest prices at home and fill the ocean refrigerators with a class of beef which will sell well abroad, and compete so successfully with the foreign meat as to establish a permanent and growing demand. The better the stock are fattened the less will be the proportionate shrinkage in transit to the distant shambles, and consequently the less loss. Animals well fattened will always bring a percentage

more than those which are leaner; besides, the cost for freight on such cattle is much less, as the ratio of offal is also less, and the shipper has to pay as much per hundred for the offal as he does for the beef. A difference of one-half a cent on a pound in favor of a well-fattened bullock will of itself furnish a margin which will make a satisfactory profit to the shipper across the seas. Cattle coming forward this winter average, as has been stated, at least one hundred pounds less on account of the unfavorable weather which has prevailed where they have been fed. This fact teaches the important lesson that more attention and better surroundings will be advantageous in the feeding of stock. Protection from the inclemency of the weather and the mud will enable the food consumed to be assimulated in the form of flesh and fat, instead of being wasted in promoting an excess of animal heat to withstand exposure and in furnishing antidotes against these adverse and deteriorating circumstances. Economy in food must be studied and brought down to the closest possible practice, so as to produce the most gain on a given amount of food. In the large cattle districts the science of feeding may not be practiced as closely as it can be in other sections where stall-feeding is practiced, but nevertheless science in feeding there will pay, and in the older States it is a necessary auxiliary to good farming. The farmer who can market his grain in his own stable at a profit over the cost is on the road to wealth. The expense of hauling to the shipping point, the freight to the sea-board, and the waste which is always charged is saved, while the farm is not robbed each year of productive life. Stall-feeding has made England like a garden for hundreds of years, and it is the most substantial basis for preserving the well-worn lands of America from dearth and the inhabitants from penury. Let the valleys and plains of the great West be divided between the herder and the shepherd, and here let the cattle and sheep be grown where God has planted the grass in overflowing abundance and on the prairies, where the same beneficent hand multiplies the harvests to an almost unbounded extent, let the herds and flocks be fattened. In this way can the perennial grasses and the vast crops of corn be best utilized, the refrigerators floating on the ocean be filled to their utmost capacity, and the product of plain and prairie be satisfactorily exchanged for foreign gold.

DISEASES OF DOMESTIC ANIMALS.

SWINE.

Dr. EDWIN M. SNOW, of Providence, R. I., as early as the year 1861, prepared for the annual report of this department a paper on the subject of the so-called "hog cholera," a disease which, at that time, had extended as an epidemic over many of the Western and into some of the Southern States. By reference to this article it will be seen that then, as now, all the diseases incident to this class of domesticated animals were designated as cholera. He gives the following as the prominent symptoms of the malady as they manifested themselves at that time:

1. A refusal of food is the first symptom usually noticed by those who have the care of the animals, though, as will be seen hereafter, this symptom by no means indicates the beginning of the disease. The refusal of food, after it is first noticed, generally continues through the whole sickness, and food of every description is mostly refused.
2. Great thirst is constant, and large quantities of cold water will be swallowed if

it can be obtained. Even after the animal is unable to stand alone it will drink cold water with eagerness.

3. After a time, the length of which varies very much, the animal begins to show signs of weakness—reels, staggers, and, in attempting to walk, often falls down.

4. In most cases there is a diarrhea, with copious fluid discharges of dark, bilious, and very offensive matter. In a few cases there is no diarrhea, but evacuations of hard, black balls; but in some of these cases the offensive fluid matter is found in the intestines after death.

5. In a few cases there is vomiting, but this is not often severe, nor is it continuous for any length of time.

6. The external appearance of the animal is at first paler than usual, but toward the last of the sickness purple spots appear, first on the nose and sides of the head. These extend along the sides and belly, and between the hind legs, after which the animal soon dies.

7. In many cases, perhaps in a majority, ulcers are found on different parts of the body. These were particularly noticed on the insides of the lips and gums and on the feet, and were often quite deep and excavated. In some cases these ulcers were seen in the nostrils, and in one case there were extensive ulcerations in the back part of the mouth on the tonsils.

8. In some cases the legs are swollen, and the animal is lame; sometimes the ears and sides of the head are swollen and red; sometimes the eyes are sore and inflamed; sometimes swellings like carbuncles are seen, and, generally, the glands near the surface seem to be enlarged.

9. In most cases the pulse is quickened, the breathing is hurried and difficult, and there is much cough. But in some genuine cases there is no perceptible trouble with the lungs, and no important signs of disease are found in them after death.

10. The duration of the disease in fatal cases, after the first symptoms are noticed, is extremely variable. We have seen some which have died within two or three hours, others have lived many days. It is difficult, however, to fix the time of the appearance of the first symptoms. The first noticed is usually the refusal of food; but it is probable, indeed it is certain, that the sickness is in progress for a considerable period before the animal refuses food. Cases like the following are sometimes seen: A hog refuses to eat; it grows weak; staggers in walking; turns purple on the sides and belly, and dies within two or three hours after the first symptom is noticed. But, on examination after death, extensive disease is found in the intestines, or in the lungs, or in both, at a stage of development which must have required many days to reach.

These are the principal symptoms of the various diseases at present so fatally affecting swine, but recent writers and investigators have classified them under the head of many distinct and well-marked maladies. Prof. James Law, of Cornell University, in an article on the subject of hog cholera and intestinal fever in swine, published in the annual report of this department for the year 1875, gives the following synonyms of the disease so widely known as "hog cholera":—Typhoid fever, enteric fever, typhus carbuncular fever, carbuncular gastro enteritis, carbuncular typhus, pig distemper, blue sickness, blue disease, purples, red soldier, anthrax fever, scarlatina, measles, diphtheria, and erysipelas. The following is given as a definition of the above:

A specific, contagious fever of swine, characterized by congestion, exudation, ecchymosis, and ulceration of the mucous membrane of the intestines, and to a less extent of the stomach; by general heat and redness of the skin, effaceable by pressure; by small red spots, complicated or not by elevations and blisters; by black spots and patches of extravasated blood on the integument, the snout, nose, eyes, mouth, and other visible mucous membranes, and on internal organs, ineffaceable by pressure and tending to sloughing; usually by liquid and fetid diarrhea, and by a very high and early mortality.

Professor Law then gives the following symptoms of the disease:

The earliest symptoms are slight dullness, with, sometimes, wrinkling of the skin of the face, as if from headache; shivering or chilliness, and a desire to hide under the litter, are not uncommon. Some loathing of food, intense thirst, elevation of the temperature of the rectum to 104° F., and increased heat and redness of the skin are usually the first observed symptoms, and occur one or two days later than premonitory signs above mentioned. The increased heat of the skin is especially noticeable inside the elbow and thigh, and along the belly. By the second day of illness the whole surface feels hot, and in white pigs is suffused with a red blush, which may pass successfully through the shades of purple and violet. It is usually more or less mottled at particular

points, and a specific eruption appears as rose-colored spots of from one to three lines in diameter, sometimes slightly raised so as to be perceptible to the touch, and either pointed or more frequently rounded. The redness fades under the pressure of the finger, but only to reappear immediately. The eruption is usually abundant on the breast, belly, and haunch, the inner side of the forearm and thighs, and the back of the ears. It stays out for two or three days, and may be followed by one, two, or more successive crops of the same kind. The cuticle is sometimes raised in minute blisters, a feature which distinguishes this from the rash of typhoid fever, and the liquid of such blisters inoculated on other pigs communicates the disease. In addition to the rash, and simultaneously with it, or soon after, there appear on the skin numerous spots of a dark red or black color, varying in size from a line to an inch in diameter, on the color of which pressure has no effect. These are due to the extravasation of blood, or of its coloring-matter from the blood-vessels into the tissue, and they dry up into thin scabs or sloughs if the animal survives.

Similar petecchial spots appear on the muzzle, in the nose, and on the eyes, and in some instances they are confined to these parts. The tongue is covered by a brownish fur.

From the first the animal is sore to the touch; but, as the disease develops, the handling of the animal is especially painful, and causes grunting and screaming. The pig lies on its belly, and, if compelled to rise and walk, moves stiffly, feebly, unsteadily, and with plaintive grunting. This weakness and prostration rapidly increases, and often ends in utter inability to rise or to support the body on the hind limbs. A watery discharge from the nose, followed by a white muco-purulent flow is not uncommon. A hard, barking cough is frequently present from the first, and continues to the last. Sickness and vomiting may be present, but are far from constant. The bowels are often confined at first, and in certain cases, and even in nearly all the victims of particular outbreaks, may remain so throughout, nothing whatever being passed, or only a few small black pellets covered by a film of mucus. These cases are quickly fatal. More frequently, however, they become loose by the second or third day, and diarrhea increases at an alarming rate. The passages are first bilious, and of a light or brownish yellow when not colored by ashes, charcoal, or the nature of the food. But soon they assume the darker shades of green and red, or become quite black and intolerably offensive. In such cases the elements of blood, inspissated lymph, and membraneous *pellicles* sloughed off from the ulcerated surfaces are usually to be found in them.

The diarrhea becomes more profuse, watery, and fetid; the pulse sinks so as to become almost imperceptible; the cough becomes more frequent, painful, and exhausting; the breathing is more hurried and labored, and the weakness increases until the patient can no longer rise on his hind limbs. At this period the petecchiæ become far more abundant. Before death the animal is often sunk in complete stupor, with, it may be, muscular jerking or trembling, or sudden starts into the sitting posture, and loud screams. In the last stages involuntary motions of the bowels are common.

Exceptionally swellings appear on the flank, with extreme lameness, and extensive sloughs of the skin of the ears or other parts. Palpitations of the heart also occasionally occur as precursors, attendants, or sequels of disease. If the disease should take a favorable turn, slight causes may make an early and perfect recovery, a complete convalescence being established in three or four weeks. A considerable proportion of the survivors, however, linger on in an unthrifty condition for months, evidently suffering from the persistent ulceration of the intestines, or infiltration of the lungs. The mortality often reaches 80 or 90 per cent. of all swine exposed, and in case of a certain number of the survivors recovery brings no profit to the owner.

These diseases among swine had spread so rapidly, and the aggregate annual losses had become so enormous, that the present Commissioner of Agriculture, shortly after assuming the duties of his position, determined to use the limited means at his command in a preliminary investigation, not only of the diseases affecting this class of farm stock, but also the many diseases affecting all other classes of domesticated animals. With this object in view the department addressed circular letters to all its correspondents, and also to many prominent stock-breeders and raisers in various sections of the country, asking for information as to the existence, extent, symptoms, and mortality of the diseases now and heretofore prevailing among farm animals in their respective localities. These circular letters were forwarded to every county in the United States, and the result has been to elicit a mass of information which, if it should result in nothing more valuable than a better sanitary condition and improved hygienic treatment of farm stock, will, perhaps, have accomplished all that could be expected in such preliminary examination.

The Senate of the United States (by resolution adopted February 20, 1878) having called for such information as was then in possession of the Commissioner of Agriculture relating to the diseases of domestic animals, a large number of the papers and letters, and the statistical returns received up to that date, were forwarded without delay. The Senate ordered the publication of this information for its own use, but the number of copies issued were so limited that it has been deemed advisable to insert the more important papers and letters in this volume of the annual report of the department.

Perhaps the most exhaustive paper on the subject of the diseases of swine is the one contributed by H. J. DETMERS, V. S., and vice-president of the American Berkshire Association. He has given the subject much attention and study, and his conclusions are worthy the consideration of those interested in a solution of the problem, or rather a discovery of the causes producing the various disorders known as "hog cholera." Professor Detmers, it will be observed, classifies the many diseases incident to swine under the general head of "epizootic and enzootic diseases of swine," or "epizootic influenza of swine." His paper is as follows:

It is well known that some very fatal and destructive diseases of an epizootic and enzootic character have been, and are yet, prevailing among swine in several parts of the Mississippi and Missouri valleys. The farmers, not understanding the morbid processes, and not knowing or rather not seeing the causes which produced the mischief, and finding the diseases to be very malignant and epizootic (affecting many animals at the same time), bring them all under one head and give them the rather strange and decidedly improper appellation of "hog cholera," a name which has wrought a great deal of mischief. It conveys the very erroneous idea that the disease or diseases so called must be identical with, or at least similar to, the cholera of men, consequently very contagious, and a product, not of common and local, but of very uncommon and extraordinary agencies and influences. As a natural consequence, the real causes, although near enough at hand, are overlooked and entirely disregarded, or considered as something innocent or out of the question, and improbable, imaginary, and unknown or mysterious influences and agencies are looked upon as the possible causes. As a further consequence, almost every one who suffers losses, instead of looking the facts squarely in the face by investigating the causes, endeavors to discover specific remedies which do not exist and can never be found. Even State legislatures have offered high premiums for such a discovery. All this diverts attention from the existing facts as revealed by the morbid process and by the morbid changes found at *post-mortem* examinations, and prejudices the minds of a great many observers.

About a year ago I spent (at the request of the Missouri State Board of Agriculture) nearly a month, from August 11 to September 4, in several counties of Missouri, for the purpose of investigating those diseases of swine known to the farmers as "hog-cholera." I examined several hundred sick animals in the counties of Jackson, La Fayette, and Saint Charles, and made, during the time mentioned, almost daily *post-mortem* examinations, not only of hogs that had just died, but also of animals affected with disease in every stage of development, which were killed by bleeding for that special purpose. The premises on which the diseased animals had been kept were carefully examined, and the care and treatment which they had received before getting sick, and the mode and manner in which they had been kept, were ascertained by diligent inquiry and observation. Hence considerable material, sufficient to form an opinion as to the nature and real causes of the disease, or rather diseases, was collected.

Before I proceed further I wish to remark that I intend to restrict my report or communication to what I have seen and observed myself, knowing very well that still other diseases of swine, such, for instance, as various forms of anthrax, and even morbid affections caused by the presence of intestinal worms, are also called hog cholera by a great many farmers, and—one should scarcely believe it, but it is true—by a large number of agricultural papers.

Intestinal worms are a very common occurrence in an omnivorous animal like a hog, but the same, if *trachina spiralis* and *cysticercus cellulosæ* (the well-known bladder-worm of *tænia solium*) are excepted, seldom cause very serious damage, provided the hog is otherwise healthy, and is well kept and well fed. As to anthrax diseases, I do not think they are very frequent in the West; at any rate, I have had no occasion to observe any of the various forms of anthrax plainly developed in swine since I have lived in Kansas (nearly five years). Excluding anthrax diseases and disorders caused by intestinal worms, I have said that *diseases* (more than one) are called hog cholera, because

the symptoms of disease, and especially the morbid changes found at the *post-mortem* examinations, differ so much in different patients as to make it impossible to assign them all to one and the same disease. Still, as the morbid process is essentially the same in every case, and the differences presented are mainly due to the fact that the seat of the disease is sometimes in one organ or set of organs, and sometimes in another, the diseases may be considered as closely related to each other, and, from a practical stand-point, it may be advisable to treat the same as members of one family, or as different forms of one and the same morbid process.

THE NATURE OF THE DISEASES.—In a majority of cases the morbid process presents itself as a catarrhal-rheumatic and in others as a gastric-rheumatic or bilious-rheumatic inflammation, and exhibits always, more or less plainly, a decidedly typhoid character. As a catarrhal-rheumatic inflammation, it has its principal seat in the mucous membranes of the respiratory passages, in the substance of the lungs, in the pulmonal pleura or serous membrane coating the external surface of the lobes of the lungs, in the costal pleura or serous lining of the internal surface of the chest, in the diaphragm, and in the pericardium or serous sac inclosing the heart. As a gastric-rheumatic inflammation, the principal seat of the disease is found in the abdominal cavity, but especially in the liver, in the spleen, in the large and small intestines, in the kidneys and ureters, and in the peritoneum or serous membrane lining the interior surface of the abdominal cavity, and constituting the external coat of most of the organs situated in that part of the body. The name of "hog cholera," therefore, as has been said before, is, in more than one respect, an ill-chosen one. It should be abolished at once, and a more appropriate one should take its place. As such a one, I have proposed "EPIZOOTIC INFLUENZA OF SWINE," for two reasons:

First, the disease bears, in all its morbid features, and especially in the diversity of its forms, produced by the differences of the parts or organs which in different animals become the seat of the morbid process, a striking resemblance to the yet well-remembered epizootic influenza of horses, which a few years ago swept the whole country from the Atlantic to the Pacific. Still I do not wish to be understood as saying that the epizootic influenza of swine is identical with the epizootic influenza of horses. The resemblance, besides the epizootic spreading and the typhoid character, is limited to the symptoms and to the morbid changes. An important difference is presented by the greater malignancy of the disease of swine.

Secondly, a name derived from a conspicuous or characteristic symptom, or from an important and constant morbid change—pleuro-pneumonia of swine, for instance—might be more convenient if the main seat of the morbid process were always in the lungs and the pleura, or invariably the same in every patient; but, as the seat of the disease is not limited to the respiratory apparatus, but is also frequently formed in the parts and organs situated in the abdominal cavity, and sometimes even in the centers of the nervous system, a name should be chosen comprehensive enough to cover all the different forms in which the disease is able to make its appearance, and, at the same time, sufficiently distinct to prevent diagnostic confusion. Epizootic influenza of swine will, I think, answer the purpose.

SYMPTOMS AND MORBID CHANGES.—As the morbid process has its seat in various parts or organs of the animal body, the disease presents itself in different forms and manifests itself by different symptoms, so that, at any rate, besides other complications, two principal and two subordinate forms or varieties must be discriminated.

1. THE CATARRHAL-RHEUMATIC FORM.—This is the most frequent of the two principal forms. The morbid process has its main seat in the respiratory organs; the disease presents the features of a respiratory disorder, and either the catarrhal or the rheumatic character predominates, or both are equally developed. If the latter is the case, the whole respiratory apparatus may be found diseased. If the catarrhal character is the one most developed, the principal seat of the disease will be found in the larynx, in the windpipe, in the bronchial tubes, and, to a greater or less extent, in the substance of the lungs. If the rheumatic form is the predominating one, the principal morbid changes occur in the serous membranes of the chest (the costal and pulmonal pleura and the pericardium), and also to some extent in the tissue of the lungs. In most cases, however, the catarrhal and rheumatic character are blended with each other, and the respiratory passages, the tissue of the lungs, and the serous membranes, or portions of them, are more or less diseased. Animals affected with the catarrhal-rheumatic form indicate the presence of the disease by a short and more or less hacking cough—generally one of the first symptoms—by difficulty of breathing, a parting or drawing motion of the flanks at each breath, by holding the head in a peculiar, stretched, and somewhat drooping position, by a slow and undecided gait, a peculiar hoarseness when caused to squeal, &c. The attending fever is severe enough to announce its presence by unmistakable symptoms, such as accelerated pulsation, changeable temperature, &c. Some of the sick animals show at the beginning of the disease a tendency to vomit, and have diarrhea, while others are more or less constipated from the first, and remain so until the disease is ready to terminate in death. If the catarrhal character is the most prevailing, but especially if the morbid process has developed

principally in the throat and in the windpipe, more or less outside swelling (quinsy) will make its appearance.

At *post-mortem* examinations some important morbid changes are found invariably in the lungs. Portions of the same have become impervious to air by being gorged with exudation. The diseased tissue has lost its spongy texture—has become heavier and more morbid, and similar in consistency to a piece of liver, a condition called "hepatization." In some cases the diseased or hepatized parts of the lungs present a uniform red or reddish-brown color, an indication that the exudation has been produced and deposited in the tissue of all the diseased lobules at the same time or without interruption. In other cases the diseased portions of the lungs present different colors; some are red, some brown, and others gray or yellowish-gray, which gives the whole hepatized part a somewhat marbled appearance, and shows that the exudation has been produced and deposited at different periods. The gray hepatization, which in such a case is the oldest, and the brown, which comes next in age, frequently contain a few tubercles, with even here and there a small ulcer interspersed. Otherwise neither ulceration nor suppuration has been observed. Important morbid changes are usually also formed in the serous membranes of the thorax. The same consist in a more or less firm coalescence between parts of the pulmonal pleura and the corresponding parts of the costal pleura or of the diaphragm, and in an accumulation of a larger or smaller quantity of straw-colored water or serum in the chest. In some cases, especially those in which the rheumatic character has been very predominating, the morbid products of the diseased serous membranes are frequently very copious; the adhesion between the costal and pulmonal pleura, or between the internal surface of the walls of the thorax and the external surface of the lungs, is usually very extensive, and parts of the posterior surface of the lungs are sometimes found firmly united with the corresponding surface of the diaphragm or membranous partition between the chest and the abdominal cavity. The quantity of serous exudation or straw-colored water deposited in the chest is often very large, and the pericardium, too, in most cases, contains a larger or smaller quantity, sometimes enough to interfere seriously with the functions of the heart, and to constitute in that way the immediate cause of death. The blood is found to be thin and watery in every case, coagulating rapidly to a uniform but rather pale-red clot of a loose texture. Its quantity is always very small.

2. THE GASTRIC-RHEUMATIC FORM.—This form presents itself not quite so often as the catarrhal rheumatic, but is fully as malignant, and constitutes the second main form which the disease is found to assume. The morbid process has its principal seat and produces the most important morbid changes in some of the organs situated in the abdominal cavity, but especially in the liver, in the spleen or milt, in the kidneys and ureters, in the intestines or guts, and almost invariably in the peritoneum or serous membrane which lines the interior surface of the abdominal cavity and constitutes the external coat of nearly every intestine.

The symptoms which present themselves while the animal is living differ not very conspicuously from those observed in the catarrhal-rheumatic form. The short, hacking cough, characteristic of the latter, is more or less wanting; the difficulty of breathing is less plain; the weakness in the hindquarters and the staggering or unsteady gait observed only in a limited degree in the catarrhal-rheumatic form are more conspicuous, and the fever is fully as high in one form as in the other. In some cases the affected animals arch their backs, or rather the lumbal portion of the same, to a very high degree, and form an outline similar in shape to an ~. I observed this especially in such cases as those in which the seat of the disease was found to be in the kidneys and in the ureters, and in which a large quantity of serum or water had accumulated in the abdominal cavity. Animals affected with the gastric or bilious-rheumatic form are usually more or less constipated. The dung, which is voided in form of small, irregular-shaped balls or lumps, is often coated with a layer of grayish or discolored mucus, and has the consistency of shoemaker's wax. Toward the end, however—that is, if the disease has a fatal termination—the costiveness usually disappears, and is followed by a profuse and very fetid diarrhea, which may be looked upon in every instance as a forerunner of death.

The principal morbid changes, as I have found them, are as follows:

1. Degeneration of the liver, brought about by a copious exudation infiltrated into the tissue of that organ. Such a degeneration, although not a constant morbid change, is found quite often. In some (not very frequent) cases a few tubercles and in others (still less frequent) even a few very small abscesses have been found imbedded in the diseased substance of the liver.

2. Morbid enlargement of the spleen or milt. I found this change in nearly every case. In some cases the enlargement was not very conspicuous, but in others the spleen was more than three times its natural size, was perfectly gorged with blood, presented a dark or black brown color, and was so soft that a very slight pressure with a finger was sufficient to sever its tissue.

3. In quite a large number of cases I found either one or both kidneys diseased and

enlarged, and presenting an inflamed appearance. In one case both kidneys and both ureters exhibited a high degree of inflammation and considerable gangrenous destruction. The latter, however, was probably not a consequence of the disease; the animal had been drenched repeatedly with oil of turpentine, and was the only one in which I found any gangrene. In another animal, which, by the way, was already convalescent, and was killed by bleeding, I found one kidney enlarged to three times its natural size, its pelvis very much distended, and its funnel-shaped ureter dilated to such an extent (where it proceeds from the kidney) as to present a diameter of nearly one inch and a half. The walls of the ureter were very thick and callous, especially at its anterior, funnel-shaped end, and the latter contained in its interior a semi-solid fibrous substance, which occupied the whole cavity and extended even into the kidney.

4. In some cases I found the membranes of the intestines or guts, but especially those of the jejunum or small intestines, the coecum, and colon or larger intestines, and also of the rectum, in a more or less inflamed and degenerated condition. In two cases a whole convolution of the jejunum had united to an almost solid bunch. On opening the latter I found in each case all three membranes, but particularly the external or serous membrane and the internal or mucous membrane very much swollen and degenerated, the passage nearly closed, and in a small cavity in the center of the bunch one (in one case) and two (in the other) large round worms (apparently *Echinorhynchus gigas*) imbedded. In another case I found, besides other morbid changes, a few round worms in the stomach, and in the mucus membrane of the guts or intestines a large number of callous scars, such as are usually left behind where the gigantic *Echinorhynchus* or hook-headed worm has been fastening itself. These three cases are the only ones in which I have found any entozoa or worms in the digestive canal.

5. In almost every case I found larger or smaller portions of the peritoneum or serous membrane which lines the inner surface of the walls of the abdominal cavity and the external surface of nearly every intestine swelled, more or less inflamed, and morbidly changed. In some cases even a coalescence between parts of the intestines, especially of jejunum and rectum and the walls of the abdominal cavity had been affected. In one case a part of the jejunum had become firmly united to the lower border of the right lobe of the liver, and in another the whole rectum adhered so firmly to the upper wall of the pelvis and of the posterior part of the abdominal cavity, that it required the use of the knife to effect a separation.

6. In every animal that had been affected with the gastric-rheumatic form I found a larger or smaller quantity of straw-colored water or serum and small lumps and flakes of coagulated fibrine in the abdominal cavity; in some cases the quantity was quite large and in others comparatively small.

As subordinate or complicated forms, I look upon such cases in which either one of the principal forms—the catarrhal-rheumatic or the gastric-rheumatic—is essentially modified by being complicated with an affection of the brain and its membranes or with a serious disorder of the lymphatic system. Two subordinate forms, therefore, must be added.

3. THE CEREBRO-RHEUMATIC FORM.—The same, though always blended with and to a certain extent subordinate to, one of the principal forms, has been observed in a large number of sick animals. The latter, besides exhibiting all the symptons of one or another of the two principal forms, shows also plain indications of a morbid affection of the brain. The same consists principally in partial or perfect blindness, a very staggering gait, and aimless movements in general. On opening the skull, I invariably found more or less swelling in the membranes enveloping the brain, a larger or smaller quantity of serum deposited inside the dura mater (hard or external membrane), the substance of the brain more or less softened, and the ventricles (small cavities) of the brain filled with serum. The other morbid changes found did not differ from those described under the head of catarrhal-rheumatic or gastric-rheumatic forms respectively.

4. THE LYMPHATIC-RHEUMATIC FORM.—The same, too, has been observed quite often, but always as a complication of one of the principal forms described—subdivisions 1 and 2. The whole morbid process presents a somewhat scrofulous character. The lymphatic system is plainly affected; tumors and ulcers, showing a scrofulous character, are found in various parts of the body, but especially on the gums. Hence there can be no doubt that such cases, although complicated and blended invariably to such an extent with one or another of the main or principal forms as to make it impossible to draw distinct lines, have to be looked upon as a subordinate form with a lymphatic character. I have been informed repeatedly by reliable persons that in some of the sick animals cutaneous eruptions have constituted one of the most conspicuous symptoms of the disease. If this is a fact, it is possible that yet a fifth form has to be added—*erysipelatous*. Still I had no chance to examine such a patient, notwithstanding I have examined a large number of sick animals, exceeding, I should judge, one thousand. I am, therefore, not prepared to decide whether the cutaneous eruption is a product of the same causes or influences which are at the bottom of the other mor-

bid changes, or whether the same is an independent disease, and merely an accidental complication.

It is probably not necessary to mention that all the morbid changes which have been described as the products or attendants of a certain form are but seldom found as a total in one and the same animal, as some of them are either usually missing or but little developed. Neither will it be essential to state that even the two principal forms of epizootic influenza of swine, leaving the subordinate forms out of consideration, are scarcely ever observed entirely independent of each other or without being in the least complicated with each other; that, on the contrary, the gastric-rheumatic and the catarrhal-rheumatic are not seldom blended with each other to such an extent as to make it very difficult to decide which one has to be considered as the most predominating. In each case the symptoms, too, are blended with each other, and morbid changes, frequently of equal importance, are found in both large cavities, in the chest and in the abdomen. These facts are easily understood by any one who is at all familiar with pathology and with morbid anatomy. The main or predominant character of epizootic influenza of swine is always rheumatic, and the principal seat is in the system of serous membranes which abound in every large cavity of the animal body. Serous membranes not only line the interior of those cavities, but constitute also the external coat of nearly every internal organ. Hence it is but natural that such a disease localizes itself in many different parts of the animal organism, produces in consequence different morbid symptoms, and causes different forms of disease. It is true that in some cases the disease exhibits a prevailing catarrhal character, but if it is taken into consideration that the causes of rheumatic affections and of catarrhal diseases are often essentially the same, and that not only the seat but the character of the disorder depends frequently upon an individual predisposition of the animal, a further explanation will not be needed.

THE CAUSES.—To ascertain the causes has been my principal object. It was, therefore, necessary to observe a large number of cases, and to investigate the disease in different localities. This I have done, and have come to the conclusion that at least some of the causes, and I think I make no mistake if I say the most important ones, are of such a nature as to admit removal, notwithstanding they are diverse and numerous, and have their source, to a certain extent, in the manner of farming and stock-raising, or rather hog-raising, customary in the West. Although I will not deny the possibility of an existence of certain agencies of a miasmatic character, nor the possibility of a presence of a micrococci or other microscopic sporules calculated to act as a cause or to contribute in producing the disease, I must confess that if anything of that kind has been acting as a cause, it has escaped my notice. In the first place I had no microscope at my disposal, and secondly I have not been able to discover anything in the whole morbid process nor any morbid change that cannot be the product of those noxious influences which I consider as the main, if not exclusive, causes of the disease, and which in my opinion are well able to produce every one of those morbid changes which I had an opportunity to observe. Those injurious influences or agencies which I am obliged to consider as the principal causes act in different ways, and, for a better survey, may be divided into three classes. As belonging to the first class I look upon everything that will interrupt or disturb the perspiration; in the second class I place all such noxious influences and agencies as interfere directly with the process of respiration; finally, in the third class I put all such noxious agencies or injurious influences as tend to aggravate the disease if already existing, by aiding in making its character more typhoid, or which produce a special predisposition by weakening the constitution of the animal.

1. *Injurious influences which act as a cause by producing an interruption or partial cessation of the perspiration.*—These influences are numerous, and of much greater importance than one who looks at them superficially may be inclined to suppose. The skin of an animal is a very important organ; it not only serves as a protecting tegument, but has also other vital offices which are scarcely of less importance to the existence of the animal organism than those of the lungs. The skin discharges through its pores a large amount of wasted material, and absorbs aeriform and liquid substances from the outside world. Consequently it may be looked upon as an organ whose duty it is to supplement the functions of several other organs, but especially those of the lungs and of the kidneys. To ascertain the effect which a total interruption of the functions of the skin would have upon the animal organism, interesting experiments have been made by Bouley, Magendie, Gerlach, and others. A complete interruption was brought about by covering the skin of various animals with an air-tight coat of varnish, grease, or tar, and the result, according to Gerlach, was as follows: Accelerated pulsation, extraordinary fullness of the arteries till an increased discharge of urine made its appearance, somewhat accelerated breathing, trembling of the whole body, rapid emaciation, great debility, augmented secretion of an albuminous urine, which latter contained also some of the coloring matter of the gall, and a decrease of the animal temperature. The latter, however, became not very conspicuous before the animal had become emaciated and was near dying. The animals (horses) so treated died within from three to ten

days. Pigs smeared all over with grease or fish-oil, for the purpose of killing lice, died within a week, and showed the same symptoms.

The office of the skin, at least as far as the processes of elimination and absorption are concerned, bears also a very close relation to the functions of the diverse serous and mucus membranes. It is true if the skin is disqualified to perform its allotted duties, or if its functions are interrupted by some means, the same will be performed partially, but partially only, by those organs named the lungs, the kidneys, and the serous and mucus membranes in general. These organs, in such a case, have to make extraordinary efforts if the equilibrium in the organic change of matter, so indispensable to the preservation of health, is to be maintained only approximately. To maintain a perfect equilibrium is impossible, for these organs, as I have said, can, in addition to their own duties, only partially perform the functions of the skin; certain parts of wasted material will not be discharged, but will remain in the organism. The lungs, the kidneys, and the serous and mucus membranes, if I may use the expression, will be overburdened, and the consequence will be that just those organs thus weakened will be the first ones that become diseased, or have to suffer from over exertion, and from the injurious effects necessarily produced by a retention of wasted matter in the organism, and also by a constant loss of organic compounds that cannot be spared. That such loss is taking place has been proven by the experiments of Professor Gerlach, which shows that the urine in such a case carries off albumen. Further, that an interruption of the perspiration must necessarily produce a disturbance in the circulation of the blood, which results in an extraordinary flow of blood to those organs—lungs, kidneys, &c.—burdened with increased activity, and constitutes in that way a cause of congestion and subsequent inflammation, is too evident to need any further explanation.

The perspiration can be interrupted, or, in other words, the skin can be disqualified to perform its functions, by several means; for instance, by a disturbance or a partial interruption of the circulation of the blood in the capillary vessels; by congestion and inflammation; by any degeneration or morbid change of its tissue, or of a part of its tissue; by closing of its pores in a mechanical way, &c. This granted, it remains to be ascertained if those pigs and hogs which are, or have been, affected with the epizootic influenza of swine (erroneously called hog cholera) have been subjected to one or more of those just-named influences or agencies able to cause an interruption or partial cessation of the activity of the skin (perceptible and imperceptible perspiration). Taking the facts just as they have presented themselves, that question must be answered in the affirmative. My investigations and my inquiries have convinced me that in all those pigs or hogs which have suffered from or died of that disease, one or more of those causes have been at work, as I shall endeavor to show.

1. All animals affected with the epizootic influenza—at any rate, all those which I have seen, and I have seen a large number—were very lousy. Lice irritate the skin, keep it in a semi-inflamed condition, cause swelling, and, finally, a gradual degeneration of its external layer—beyond a doubt constitute to some extent a disturbance of normal perspiration.

2. All the hogs and pigs which had contracted the disease had been exposed night and day to all the sudden changes of temperature and weather so frequent in the Western States. Some of the animals had been kept in small, wet, and dirty yards and inclosures, without a roof to protect them; they had to suffer during the day from the rays of the sun, and from the heat which naturally accumulates in a small space or lot walled in by a tight fence, and which is constantly increased by the decomposition of wet manure and other organic substances. During the night the same were exposed to the chilling influence of the cold night air and the frequently very heavy dews, not to mention the effect of severe rains and thunder-storms. Further, after each rain the animals thus kept had a chance to get the entire body covered with mud and the pores of the skin thoroughly closed; but an opportunity to get rid of the dirt by taking a bath was never given. Such influences, evidently, are very apt to cause irregularities in the circulation of the blood in the capillary vessels of the skin and an interruption of the perspiration. Other animals have been kept in comparatively large herds, and have been allowed to run at large in a barn-yard, in a so-called hog-lot, in the woods, &c. These, too, were exposed more or less to the burning rays of the sun during the day, and at night, in most cases, they found shelter under a corn-crib, under an old stable or an old barn—at any rate, in the closest and dirtiest places, where they lacked room, and where they often crowded on top of each other when retiring to sleep. As a consequence the animals became heated, and, perspiring, as they left their lair in the morning took cold on coming in contact with the chilled atmosphere. A sudden cooling, however, or a sudden reduction of the temperature of the surface of the body is apt to effect a contraction of the capillary vessels of the skin, hence a diminished supply of blood, and, in consequence, a decrease or partial interruption of the functions of the skin.

The animals, thus suddenly cooled by the morning air and the wet dew, become, in the course of the forenoon, again exposed to the rays of the sun and the heat of the day, which induces them to go to the first pool of water, if one is accessible, to take

a bath. This is all right and well enough, because in the summer a hog should have access to water and an opportunity to take a bath as often as it desires. In all those places, however, in which the disease had made its appearance, I found the water to which the hogs had access almost invariably so shallow and of such a limited quantity that the bathing and wallowing of one or more animals was sufficient to convert the same into sticky, semi-fluid mud. Consequently, if the herd was a large one, but a very few animals—and those invariably the stronger and most active ones—had now and then a chance to find clear water, and to reap real benefit from taking a bath. All others, especially the younger and smaller animals, were compelled to wait until the first comers were through with their bathing and had changed the water to mud; the former, therefore, had scarcely ever an opportunity to clean themselves from the mud of the preceding day, and to open the pores of their skin by taking a bath in clean water. If they wished to take a little cooling they had to be satisfied with taking a mud-bath, and as every new bath was a mud-bath again, the pores of the skin, instead of being opened, became closed more and more effectually from day to day, until finally the perspiration was thoroughly interrupted, and disease made its appearance as the natural result.

It is different where the herd is a small one, for then nearly every animal will sometimes have a chance to open the pores of its skin in tolerably clear water, and the perspiration will not be seriously interrupted. That these deductions must be correct is proved by the fact that in every large herd nearly all the younger and weaker animals (shoats) have become a prey to the disease, while the larger or stronger and most active animals, which are usually the first ones to go to the water in the morning while it is measurably clear, have either remained exempt or have contracted the disease in a mild form, and have mostly recovered. Finally, small herds have either suffered fewer losses, have been less severely attacked, or have remained exempted altogether. The injurious effect produced upon the system of the animal by the muddy and filthy condition of the water, which most animals so situated have been compelled to drink, will be explained hereafter.

2. *Agencies and influences which interfere directly with the process of breathing.*—These, too, as already indicated, are of different nature. When I first commenced my investigation it struck me that all those swine—pigs, shoats, and grown hogs of every age and description—which run at large in the streets and thoroughfares of Kansas City, Westport, Independence, Lexington, and other towns and villages, and lead the most independent life possible, but do not congregate—go home in the evening, and belong to persons who own but one, two, and maybe three animals; as also all those swine which are kept by themselves, either one by one or only a few together; and, finally, all those which are kept in comparatively small herds in pastures, orchards, or woods, coated everywhere with grass and perfectly destitute of dusty, bare ground and old manure-heaps, are, and have been, with rare exceptions, perfectly healthy. I say with "rare exceptions," for it has been reported to me that a few of those swine running at large in the streets have died, but I have not been able to ascertain the causes of their death.

On the other hand, the herds which have been kept in yards, pastures, fields, &c., consisting partially or wholly of bare, dusty ground, or containing heaps and accumulations of old manure, have and are suffering severely, and the more according to the size of the herd and the worse the dust of soil and old manure. In large herds, composed of one hundred head or more, the mortality has been as high as from 70 to 90 per cent.; in smaller herds from 25 to 60 per cent., and where only a few animals were kept together, and consequently each animal was only compelled to inhale the dust kicked up by itself and occasionally by one or two others, the mortality has been comparatively low—has seldom exceeded 10 per cent., or fatal cases have not occurred at all. Further, in all those cases in which the hogs or pigs had been compelled to inhale with nearly every breath a large quantity of soil and manures, ground to powder by rolling, tramping, and the rays of the sun, all the *post-mortem* examinations revealed as principal morbid changes a morbid affection of the eyes, inflammation of the respiratory passages (throat, windpipe, bronchial tubes), hepatization of the lungs in various stages of development, and, in some cases, even tubercles or a few small abscesses in the pulmonal tissue, while the serous membranes (costal and pulmonal pleura, pericardium, and peritoneum) presented a comparatively healthy condition, except in those cases in which the causes described in subdivision 1 had been acting together with those under discussion. If these facts are duly taken into consideration, scarcely any doubt can remain as to the constant inhalation of powdered soil and manure constituting one of the principal causes of the epizootic influenza of swine.

As another noxious influence tending to interfere with the process of respiration, or injuring the respiratory organs, may be considered the gases or effluvia emanating from old decomposing manure heaps and from dirty and filthy pig-sties and hog-yards. Still, I must look upon them as something of subordinate importance—not *per se*, but compared with the more substantial agencies—and, therefore, do not deem it necessary to enter into further details.

3. *Causes which weaken the constitution, produce predisposition, and develop or promote the typhoid character of the disease.*—As such have to be mentioned: 1. Foul and impure water for drinking. As a general rule, hogs are usually compelled to drink either out of a dirty trough, if confined in a sty, or from muddy pools and wallows, if kept in pasture, &c., and, therefore, are frequently obliged to drink water that is not only muddy and impure, but even stinking and full of decomposing organic substances. That such water is apt to develop microscopic animal and vegetable growth, is often inhabited by the brood or the larvæ of various species of intestinal worms, and thus prepared to convey numerous germs and causes of disease to the animal organism—maybe more than are introduced in any other way—is a well known fact, and does not need any explanation. 2. The filth and manure that is consumed with the food. On almost every Western farm (at any rate on all those on which I found the disease) the swine are fed with corn in the ear; the ears of corn are thrown into the pig-sty, yard, or feeding-lot, as the case may be, but always in a place full of manure and dirt, either wet or dry. As a consequence, the animals can scarcely pick up a kernel of corn that is not soiled with filth, and are obliged to consume a great deal of nastiness. That such wholesale consumption of filth and excrements must finally undermine the constitution of even the healthiest animal, and must give to any disease that may happen to exist or to appear a typhoid character, is self-evident. 3. On a great many farms in the West the corn-cribs are either insufficiently covered or not covered at all, and, as a consequence, a great deal of the corn fed in the spring and during the summer is moldy and rotten. Moldy corn does not constitute healthy food; on the contrary, it is poisonous if consumed in large quantities; at any rate, it weakens the constitution, promotes and produces disease, especially of the respiratory organs and of the kidneys, and is well calculated to give any disease a decidedly typhoid character. 4. One very common mistake in feeding may also be mentioned as perhaps not entirely without influence. I refer to the practice of feeding nothing but corn. It may suffice, however, to say that corn does not contain in a due proportion all the elements necessary to the growth and development of an animal; it is destitute of some and contains others in too small a proportion. Hence a variety of food is just as necessary to a hog as to any other animal, if health and vigor are to be preserved. To enter into particulars would lead too far.

One may ask, if the causes of the disease are of such an ordinary character, how can it be possible that it has become such an extensive epizooty? The answer is not difficult. A satisfactory explanation can be given. 1. Notwithstanding the most diligent search and patient inquiry, I have not been able to discover any injurious influences or agencies, in addition to those enumerated, that have acted upon all of the diseased animals, or upon a large number of the same, which can be taken into consideration as possible causes. 2. The treatment or keeping of swine is essentially the same almost everywhere in all the Western States. The causes mentioned are, therefore, sufficiently discriminated or general enough to produce an epizootic. A great many farmers, who are frequently careless enough in the treatment of even their horses and cattle, usually think that a hog is but a "hog," and it can get along with "hoggish" treatment—that it delights in nastiness, filth, and dirt of every description, and does not need a dry, comfortable, and clean resting-place during the night, clean and sound food, clean and fresh water for drinking and bathing, nor shade and shelter against the burning rays of a Western sun, against wet and cold and the sudden changes of weather and temperature in general. But they are very much mistaken; there is probably no animal which repays good care and rational treatment more than the hog. Still, if nature had not endowed the same with such an excellent constitution, pork might have become, before this, a very rare article.

Some one may say, "If the principal causes of the disease have their source in the manner in which the swine are raised, kept, and provided for, which does not differ essentially from former years, how does it happen, or how can it be explained, that the disease made its appearance as an epizooty only a few years ago, and not before?" While the country was new, hogs were not so numerous as now, or at any rate were not kept in such large herds; pig-sties, hog-lots, and swine-pastures contained not so much accumulated filth and manure, nor so many bare and dusty places as they do now. In the course of many years the excrements and other decomposing organic substances have not only accumulated on the surface of the premises where hogs are kept, but the ground and water have also become impregnated with the same. The disease, I do not doubt, will still spread and increase in malignancy in the same proportion in which dung and dirt are allowed to accumulate, and in which the size of the herd is increased.

Is the epizootic influenza of swine a contagious disease?—To tell the truth, I am not prepared to decide that question, because such a decision requires numerous experiments, and these I have not been able to make. A great many farmers believe, nay, hold themselves convinced, that the disease must be contagious, and have furnished me with facts which I admit seem to point very strongly that way. Still I think the epizootic character of the fearful spreading of the disease can be satisfactorily explained

without the existence of a contagion. The fact that the hogs and pigs running at large in the streets of the towns and cities are, with rare exceptions, healthy and remain exempted from the disease, notwithstanding they are much more exposed to contagions or contagious infection than any others, goes far to show that the disease is probably not contagious.

Duration of the morbid process.—In some cases the disease has had a fatal termination within two days after the first plain symptoms of sickness had made their appearance, and a few cases have been reported to me in which the animals have died within from six to twelve hours; but as to the latter cases, I am inclined to think the first symptoms have escaped observation; a very common occurrence in diseases of swine. The average duration of the disease may be set down as from five to fifteen days. Still some animals have been sick from three to six weeks, but as most of these recovered, a part of that time should be looked upon as belonging to the stage of convalescence, or, if the patient died, the disease was protracted by relapse.

Prevention.—The measures of prevention consist in removing the causes or in treating the swine in a rational manner in accordance with hygienic principles. If this is done, no other special treatment nor any medicines will be needed to ward off the disease. To give medicine to healthy animals for the purpose of preserving their health is a bad practice and may be fraught with injury. The use of medicines can have but few objects, viz., to mitigate, to remove, to destroy, or to divert injurious influences. To give the same for any other purpose will do much more damage than good, and should never be done. Hence I have to caution every farmer against the use of any patent nostrums or quack medicines advertised as "cure-alls," but intended only to draw the money out of the pockets of the credulous.

But to the point: I am confident that the epizootic influenza of swine, or the disease commonly called hog-cholera, will cease to exist, or, at any rate, will lose its epizootic character and become a very rare occurrence, first, if large herds of swine are divided into smaller ones containing only a few (three or four) animals each; second, if each lot, consisting of a few animals, is provided with a comfortable pen or sufficiently-protected resting-place to sleep in, which is kept free from filth, dust, and manure, is well ventilated, and has a good roof; third, if every hog or pig has access several times a day, or as often as weather or temperature and circumstances require, to fresh and clean water for drinking and bathing, either in troughs made for that purpose or in a brook or streamlet; fourth, if no filth, manure, and other decomposing organic substances are allowed to accumulate in any of the sties, yards, pens, hog-lots, or pastures in which the hogs or pigs are kept; and, fifth, if the food is always healthy and sound and never soiled with filth and manure. I know very well that many farmers prefer to be sent to the drug store for medicine in preference to complying with these rules, and some of them may even think or say, "If I cannot keep my hogs in the old 'hoggish' fashion, but must treat them even better than I am in the habit of treating my horses and cattle, I prefer not to keep them at all." To such men I have to say, if you do not keep any hogs you certainly will not lose any, and may thus benefit yourself and your neighbor, who will reap the profit from the scarcity of hogs produced. But I can assure you that any one who will consent to treat his swine in a rational manner, as an animal ought to be treated, will gain thereby, and will receive ample compensation for his care and labor. At any rate, it will pay much better for any one to raise, for instance, fifty hogs, to keep them well and lose none and develop them into "prime porkers" or so-called "Philadelphia" hogs, than to raise one or two hundred in "hoggish" fashion, lose from 50 to 70 per cent., and produce animals that figure as inferior "light-weights" or "scalawags" in the market reports. Moreover, the amount of food which is needed to produce two hundred pounds of inferior and frequently unhealthy pork, if the pigs are kept on the manure-heap, in the barn-yard, or in small, nasty pens, will easily produce three hundred pounds of good, healthy, and palatable pork if the keeping of the animal is always in strict accordance with the laws of hygiene. If the latter are never violated, I am sure epizootic influenza will not make its appearance; but if the indifferent, or rather negligent, treatment of swine customary in the West does not undergo a thorough change, the disease will increase in frequency from year to year.

In thus giving my views candidly and in plain language, I wish to state, without any apologies, that my object is not to blame any one, but to tell the honest truth, and to point out the way which must be pursued if it is desired to get rid of the disease. The mistakes made are not committed by a few farmers and hog-raisers, but by a great many. If those who find themselves guilty of having neglected their hogs, or of having treated them in "hoggish fashion," will accept what I have said in the same spirit in which it is given, and follow my advice, they will have no cause to regret it.

Treatment.—The treatment may be divided into two parts: a hygienic and a medical. The former, which includes a removing of the causes, is in this, like in most other causes, of the very greatest importance. If the causes are promptly removed, a great many sick animals not already too far gone may be saved. If the same are not, the very best medical treatment will be of little avail. The sick animals must be separated from the

herd, must be provided with a clean and dry resting-place, must have pure air to breathe, clean water to drink, and healthy, clean, and easily-digestible food to eat.

As to the medical part of the treatment, I would recommend giving to each patient at the beginning of the disease a good emetic, composed either of powdered white hellebore (*Veratrum album*) or of tartar-emetic, in a dose of about one grain for each month the sick animal is old, provided the latter is of good average size. The largest dose to be given a full-grown animal should not exceed fifteen or sixteen grains. The emetic is best administered by mixing the same with a piece of boiled potato, or, if the hellebore (which I prefer) is chosen, by strewing the powder on the surface of a small quantity of milk, as neither boiled potato nor milk will be refused by any hog unless the animal is very sick, and in that case it will be too late to make use of an emetic. After the desired action has been produced the animal will appear to be very sick, and will try to hide itself in a dark corner; but two or three hours later it will make its appearance again, and will be willing to take a little choice food, such as a few boiled potatoes, a little milk, &c. At this time it will be advisable to again give a small dose of medicine, either a few grains (two or three to a full-grown animal and to a pig in proportion) of tartar-emetic or of calomel. Mix with a piece of boiled potato, or, if the symptoms should not have returned, mix with a small pinch of flour and a few drops of water (sufficient to make a stiff dough) and form into small round pills. I wish to remark here that a sick hog should not be drenched with medicine under any circumstances, for a drench, given by force, is very apt to pass down the windpipe into the lungs as soon as the animal squeals, and frequently causes instant death. The tartar-emetic has to be chosen if the disease has its principal seat in the respiratory organs or presents itself in its catarrhal-rheumatic form. and the calomel deserves preference if the gastric or bilious rheumatic form is prevailing, but especially if the liver is seriously affected. Either medicine may be given in such small doses as mentioned three times a day for several days in succession, or until a change for the better becomes apparent. It is also advisable, particularly if the disease exhibits a very typhoid character, to now and then mix for each animal a few drops of carbolic acid with the water for drinking or with the slops. Convalescent animals, which have become very weak and emaciated, will be benefited by giving them once a day from a few grains to half a dram of sulphate of iron (copperas) mixed with their food, but the use of iron must be discontinued if the patients become constipated or if the excrements turn black. Those convalescents in which the lungs have become hepatized to a considerable extent may receive repeatedly small doses of carbonate of potash for the purpose of promoting the absorption of the exudations deposited in the tissue of the lungs. The size of the dose of carbonate of potash as well as of iron depends upon the size and the age of the animal.

A local or external treatment is also of considerable importance. A good counter-irritant or blister, composed of cantharides, or Spanish flies, and oil, made by boiling one ounce of the former and four ounces of the latter for half an hour over a moderate fire, or for one hour in a water-bath, should be applied on both sides the chest in all such cases in which the organs situated in that cavity are seriously affected. Such a counter-irritant has usually a very beneficial result. In most cases one application will prove sufficient to relieve the animal to a considerable extent, provided the oil is thoroughly rubbed in before the disease has made too much headway, or before the vitality of the organism has been destroyed. If the effect of the fly-blister proves insufficient, it may be applied again the next day; but if the same produces no effect at all, it may be taken as an indication that the animal is going to die, and that any further treatment will prove of no avail. Fontonels and seatons have really the same effect as a fly-blister, but they act slower, are less reliable, and may otherwise cause damage, especially if the typhoid character of the disease is very much developed, by weakening unnecessarily the constitution of the patient.

In conclusion, I will mention that epizootic influenza of swine, or so-called hog-cholera, is not a new disease, nor peculiar to our country, as people seem to believe. It has been known in Europe for many years. Professor Spinola gives a description of an epizootic "pleuro-peripneumonia," corresponding almost exactly to the catarrhal-rheumatic form of epizootic influenza of swine, in his "Die Krankheiten der Schweine" (Diseases of Swine), Berlin, 1842, page 82 *et seq.* Another brief description will be found in the Austrian "Vierteljahresschrift fuer wissenschaftliche Veterinaerkunde" (Quarterly for Scientific Veterinary Science), Vienna, 1870, vol. xxxiii, part 2, page 137, copied from "Il Medico Veterinario," 1869, page 529.

It having been reported last fall that the so-called hog-cholera was prevailing to a considerable extent in Princess Anne County, Virginia, the Commissioner of Agriculture requested THOMAS M. HEALEY, M. D., of Washington, D. C., to proceed to that locality and make an investigation and report the results to this department. The following report has since been submitted by him:

Hog-cholera made its appearance here about eighteen months since, and has been wandering about from farm to farm almost annihilating the stock, reappearing from time to time on the same place, until the last hog was destroyed.

The first place I visited was Mr. Thomas Hendley's farm, about three miles from Princess Anne Court-House, where I saw the first cases of this most interesting disease.

Before going into the details of any of the cases, I desire to make some general remarks on the character of this disease. In the first place, I will consider "hog-cholera" as described in the best authorities, and then see how these descriptions stand the tests of reason and collated experience. The disease is not a cholera or a choleraic disorder, and the name is an American misnomer. As long ago as 1834 a veterinary surgeon of Aurignac, France, named Roche Lubin, a careful, shrewd observer, described an epizootic of a similar if not identical nature. He made numerous *post-mortem* examinations of swine that died of the disease, carefully recorded his observations, and gave his deductions therefrom. Since his day, until of late years, little has been done save to follow and verify his statements. He pronounced the disease a malignant fever, and called it "*charbonneuse fever*." "Charbon" is malignant pustule, a frightfully fatal disorder, in which the evacuations or juices of an animal sick with the disease are capable of communicating it to other animals and to man.

The epizootic that Lubin saw simulated many of the features of charbon. But he saw it was neither communicable to other farm animals nor to man, so he called the disease "*charbonneuse fever*," or charbon-like fever, a milder type of the malignant pustule or plague. The disease appeared from time to time among swine in various localities on the Continent and the British Islands, and acquired various names, many of them conveying the same or at least a similar idea, such as carbuncular fever, carbuncular gastro-enteritis, carbuncular typhus, typhus anthrax, anthrax fever, purples, blue disease, &c. Most of these terms, in the simple or absolute form, have been used to describe the disease common to animals and to man, but when used as adjectives with another word, such as "fever," show that it is a disease similar to the plague, but not communicable to other animals and confined to the hog, the hog, of course, still being subject, with other animals and man, to the plague or charbon. The epizootic I observed in Princess Anne County, Virginia, and the disease that has been raging over the United States for some years past, is evidently of this same type. Other farm animals do not catch it from the hog, no matter how close the contact, for in several instances I have seen dogs eat the freshly-clotted blood from the ground where I was making *post-mortem* examinations and experience no inconvenience therefrom. The disease, therefore, must be generated by a deleterious something which is hurtful to swine, and apparently to swine alone. Again, the disease has been described as highly contagious. It has been claimed that the air alone can convey the contagion. "A herd, previously healthy, was taken sick three days after being in a breeze which had blown over sick swine half a mile distant." Professor Axe, of London, made quite a number of very interesting experiments with the disease, one of which was that of confining a healthy pig in the same house, but carefully apart from another pig ill with the disease. This pig sickened on the sixth day, notwithstanding this careful separation; and I might multiply these experiments and examples to fill a volume. But against such ideas as these instances would inculcate I had a very singular experience on the farm of Mr. Thomas Hendley, before mentioned. Six pigs had died before my arrival. When I visited his place, I found the condition of things about as follows: There were about forty pigs in the stable-yard, one of which was a nearly white sow about eight months old. She was sick with the disease, and had a temperature of 105°, and showed the characteristic eruption very plainly. Another was drooping, and presented the peculiar wrinkled look about the face and eyes invariably indicative of the disease. This pig showed a temperature of 102°, and had only been ailing 24 hours. Another, a black sow nine months old, had been sick in the pen with thirteen others. After two days' sickness it was removed to a little triangular pen by itself, and had been there a week when I first arrived on the place. I visited this place and inspected these pigs for more than two weeks, and during that time not one of the thirteen pigs in the pen sickened, nor did any more of those in the yard become ill. This showed a period of twenty-three or twenty-four days' exposure to the poison of the disease.

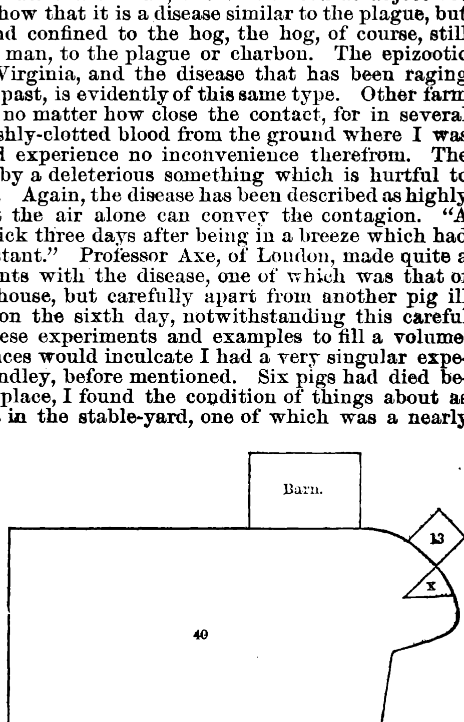


Diagram No. 1.

Again, on the farm of Mr. Jonathan Hunter I found the disease had prevailed during the spring and early summer. It broke out among the swine on the adjoining place, and he penned up those of his pigs (fifty-five) that had been exposed to the contagion in the field shown. He had another herd of thirty-two pigs that had not been so exposed, and they were in an adjoining field (Diagram No. 2), separated from the others by a worm-rail fence. Every night they came up to be fed. During the day they ranged down the lane toward the tenant's house into a woods range, sometimes even in company with the tenant's pigs, and at night laid in the field adjoining the sick swine; and yet not one of these thirty-two was taken with the disease.

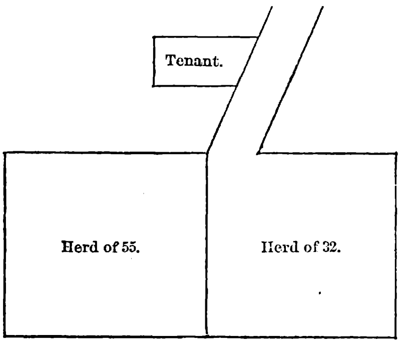


Diagram No. 2.

Again, at Mr. James McAlpin's, on the public road, about two and one-half miles from the court-house, the disease was raging severely, having destroyed over a hundred head of swine in a few weeks. The hogs of the adjoining farm across the road ranged up to the fence, on the other side of which these hogs were dying, and more than two months had passed without a single case occurring on that place.

I could give numerous examples of just such curious instances of non-contagion, but the literature of the disease, as given in newspaper articles, shows that the malady possesses very erratic properties as regards its spread by contagion. I will give some instances.

George M. Coldwell, of Williamville, Wayne county, Missouri, in answer to queries from the Saint Louis Globe Democrat as to how many hogs he had lost from the so-called hog cholera, answered:

"I lost none of my Berkshires except some pigs that were shown at four fairs, which came home sick. There were nineteen of them, and they all died. Although turned loose with the other hogs, none of them took it. I had eighty-six stock hogs that were raised on clover-fields, and as soon as corn was hard enough to feed I fed it to them. I never saw shoats do better. In from five to six weeks a disease broke out, entirely different from that which affected the nineteen head that had been at the fairs, and all the best ones died, leaving me sixteen worthless shoats of about one-half their former size and weight; and to-day, four months since they quit dying, they are not as heavy as when the cholera took them first."

In answer to additional questions, he stated that while some of his best Berkshire sows ran with the sick animals, he had lost none by the disease, nor had he lost a single pig from those sows. He did not regard the disease as contagious, and cited the fact that some of his stock, confined on the same running stream and just below affected hogs, showed no signs whatever of disease.

Mr. George Hunter, of Carlinville, Macoupin county, Illinois, says:

"Have had the disease but once on my place. On that occasion it was brought there by a diseased shoat and communicated by contagion and infection, first to the weakest pig and then to the strongest hog. We promptly destroyed the weakest and most affected, and saved all the strongest and best with but slight injury and no doctoring."

Mr. F. S. Richards, Viriden, Montgomery county, Missouri, says:

"I do not think it contagious. The disease has been for the last fifteen years on all sides of my farm, and diseased hogs have gotten into my lots and died there, yet my hogs have escaped."

In portions of the country from whence reports come affirming its contagious character, close and careful observers deny that the disease is contagious at all, and ascribe its prevalence to irregularity in feeding and improper diet, or general ill-treatment of swine, such as exposure to wet, cold, dust, &c., and the idea has pretty thoroughly obtained in certain portions of the country that these causes are sufficient to generate it. As to the period of incubation, results of observation differ as widely as opinions in regard to its contagious character. By the period of incubation is meant the time that elapses between exposure to the poison of a disease and the period of its taking effect. The simplest example is in vaccination, where inserting the virus into the arm of a person stands for the period of exposure to the disease, and the appearance of irritation around the point of inoculation (three days) for the sickening in consequence of the exposure by inoculation. In malignant pustule the period of incubation is a definite one. In the rinderpest we have again a fixed time. In almost all diseases of a highly contagious nature in animals as in man, we have a limit of time of incubation of the poison of disease rarely varying more than a few days from its shortest to its longest limit. My investigations show the death rate in this disease to be as

high as 69 per cent. of those exposed to contact with the sick, and in this I do not differ from the recorded experience of almost every one else. The disease comes, too, with a most surprising virulence, and kills with the rapidity of the most malignant of the charbon epidemics. It almost always leaves the few that do recover worthless and unfit to live. The hog cholera is as erratic in this as it is in its spread by contagion. Careful observations by Dr. Laws, in Edinburgh, in 1864, led him to set down the period of incubation at from seven to fourteen days. Dr. Sutton, of Aurora, Indiana, in 1848, in a series of experiments by inoculation, seemed to clearly arrive at a period of from thirteen to fourteen days. Professor Axe, of London, in 1875, figured it down with equal precision from six to eight days, and in the case of the wind blowing from the sick over a sound herd a half mile away, the period was three days. These, and many other observations, show that the hog cholera lacks a definite period of incubation as one of the points in its natural history.

The next point for consideration in the examination of this subject should be the symptoms of the disorder. Almost every disease has some particular feature or succession of features, by which it is recognized during life. The symptoms as a rule are constant, and appear with the disease. Sometimes other symptoms, accidentally present, may loom up into such prominence as to mask those peculiar to and distinctive of the disease; but, as a rule, close observation of the sick will show the peculiar and characteristic symptoms to be present. Lubin (Rec. de Medicine Veterinaire, pp. 120 *et seq.*, 1834), describes these symptoms as follows:

"There is general prostration of the animal; small, frequent pulse; drooping; hot and tender ears; projecting, haggard eyes; intensely red conjunctiva; lips swollen and everted, red, and sometimes foaming at the mouth. The animal hides in the litter; breathes frequently and with difficulty; emits anxious, plaintive cries; continued, convulsive movements always precede the appearance of red spots on the ears, belly, and inner portions of the thighs. These spots gradually become darker, and sometimes the individual spots unite and form large patches; partial paralysis of the hind quarters, involuntary and fœtid discharges, and death is not long delayed."

In describing the *post-mortem* appearances, he finds "the brain and nasal cavity natural; tongue red; lungs swollen and congested, covered with spots of extravasated blood, and stained brown in portions. The contents of the abdominal cavity are all congested, inflamed, and spotted, as is the skin. These spots are extravasated blood. Sometimes fluid is formed in the abdomen."

The contents of the bowels were dry, and the animal was constipated until toward the termination of the disease. He found that dogs were not affected by eating the flesh of the diseased animals, and that inoculating them with the ichorous juices of the sore spots did them no harm. In milder cases of the disease he found nearly the same symptoms during life, but after death there was observed greater disorganization of the affected parts. The inflammation seemed to run its course, and end in the softening and breaking up of the tissues.

M. Lapousil, in the same work (vol. I, pp. 475, *et seq.*, 1831), describes a similar outbreak in another part of France, and without any hesitation called the disease "gastro-enteritis, complicated with *Charbonneuse* fever." As will be seen from the above the definite points of the disease are, first, the temperature; second, petecchiæ, or spots on the skin and internal organs. The other appearances do not seem to be so constant, and appear to arise from some tendency of the disease to spend its force on some one organ more than on others. In one herd of swine the lungs seem to be most affected, in another the stomach, and the small and large intestines. According to these symptoms the disease might fairly be classed with the eruptive fevers. Again, some observers, happening on cases where the entire intestinal canal from one end to the other shows irritation, pronounce the disease of gastro-intestinal origin. Others, finding the lungs of the swine most affected, call it a pulmonary trouble, and attribute it to inhaling too much dust from dry, dusty beds. I propose here to recite my own observations, premising that I approached the subject utterly without bias toward any of these theories. I will endeavor to show that the theories held by those claiming to be best informed on the subject are not only insufficient to explain the pathological and physical phenomena of the disease, but are directly at variance with the best known and accepted theories in special and comparative pathology.

The cases that came under my observation were not many in number, and I was able to make only eight *post-mortem* examinations, but the subjects that I examined comprised typical cases of the disorder as it prevailed in the section about Princess Anne Court-House, Va., and of the disease as it is described in books on the subject. I will first, however, give an account of observations on the extent of the disease, and such other facts in its history as were obtained from the planters in the county, and then give the *post-mortem* cases together. Mr. H. B. Malbone had lost thirty hogs: four, four months old; six, five months old; twelve, two months old; four, one year old, and six farrows of pigs, averaging eight each. Some that died were constipated, would lie around the pen, poke in the corners of the fence with their snouts, stagger in their gait, and get gradually worse until they died. Some would eat heartily all

the time. One fed heartily and died immediately thereafter. Some few purged and vomited, and one or two coughed. Seven of the sick recovered. One pig, about seven months old, had it four times in six weeks; got very ill and refused to eat, rallied and ate heartily for five or six days, then got as bad as ever again; at one time it purged; at another time it was constipated. They all had the characteristic eruption. Some had lost all their hair, and looked scaly and mangy. Two had new hoofs growing out. Those that survived the disease were all in a very poor condition, save one that seemed to have recovered entirely. He had about fourteen hogs of all ages left, including those that had been ill. The herd was composed of thirty-seven hogs; thirty were sick and seven recovered. No *post-mortem* examinations were had. The average duration of disease was four days.

Mr. N. B. Moore lost twenty-six out of forty-one hogs. "The most of them were taken with vomiting and purging, and soon became feeble in their gait. They moaned and grunted all the while, and laid down and died suddenly." Others would be constipated from the first; would mope around, and would push with their snouts in the corners of the fence. These pigs all had the characteristic eruption, and during their illness, and after death, large quantities of small, whitish worms, barely visible to the casual glance, could be seen crawling out of their noses. The stomach was found full of these worms. Some of these hogs wheezed incessantly, and seemed to breathe with great difficulty, but did not cough. This herd was composed of forty-one hogs, of which thirty-nine were sick and thirteen recovered. All the animals that drooped for two or three days during the illness of the others were classed as sick.

Mr. Samuel Lovett had a herd of fourteen head, and lost four. They were costive, and had a trembling and uncertain gait, hair all staring, skin very hot, wheezed a great deal, seemed stopped-up at the nose.

Mr. J. D. James had a herd of fifty head, out of which he lost thirty-nine. Thirty-seven were six months old; two were eight months old. They were constipated, moped about, pushed with their heads against the fence, ate heartily, and coughed continually.

Mr. G. W. Fentress lost twenty-five out of fifty head. Only five recovered that had the disease. Symptoms: "Palpitation of the heart; spasmodic breathing with great oppression; some scouring; more were constipated; some highly feverish; noticed no eruption; some died with convulsions like lock-jaw."

Mr. Emmerson Legget lost eight out of twenty-five, but gave no symptoms.

Mr. H. T. Cornick lost twenty-five head out of a herd of forty. The disease was on the place for two months. Shoats five or six months old suffered most.

Mr. Emmerson Land lost one hundred and eight out of a herd of one hundred and seventy-eight. He made two *post-mortem* examinations, but discovered nothing save a generally congested appearance of the bowels. Very few that had the disease recovered, and those that did, with the exception of one sow, were trifling and worthless; she recovered, and had a large litter of fine pigs, which are all healthy and doing remarkably well.

Mr. John Mathias lost fifty-five out of seventy; none of the sick recovered; Mr. Thos. Hunter lost one hundred out of two hundred; Mr. J. H. Herrick, fifty-five out of sixty-five; Mr. Daniel Whitehouse, seventy-five out of seventy-eight; Mr. Robert Lane, forty out of sixty; Mr. Joseph C. Malone lost forty-five out of seventy-five shoats from three to eight months old; Mr. Carey Williams, twenty out of thirty-three; Mr. M. Newman, twenty-five out of twenty-six; Mr. R. McLannan, thirty out of forty; Mr. W. R. Whitehurst, twenty-four out of thirty. Mr. James C. McLannan lost all, forty-five head. The disease lasted on this place for three months. Some would have a slight cough, and soon get off their feed, would speedily get thin, drawn up, become weak, and soon die. He did not notice any red spots on those showing such symptoms. Others would be taken with vomiting and purging, and would void highly-colored urine; others again were constipated, highly feverish, spotted, and would push against the corners of the fence with their snouts.

Mr. Walter McLannan, son of the above-named gentleman, who got his stock from his father, had twenty head that herded with those that died, and only one was affected. This pig is declining in strength, and has spasmodic breathing and palpitation of the heart. Mr. Thomas G. McPherson lost over one hundred head, and Mr. Joseph Whitehurst lost forty; Mr. Henry Mathias lost seventy-five out of one hundred head; Mr. John A. Shipp lost nine. Mr. James E. Cannon, on the Eastern Shore swamp, lost thirty-nine out of sixty head, nine of which were five and the balance eleven months old. Three of these had the disease severely and recovered; eight had it slightly and recovered. Two of these were sows, and subsequently gave birth to pigs, one litter living a day and the other two or three weeks. The disease manifested all the different symptoms and phases shown during the illness of the parents.

Mr. N. W. Forbes lost ninety-six out of one hundred and fifty head. They were of various ages, ranging from six weeks to six months. Two sows were three years old. The disease lasted on this place two months. The symptoms were diarrhea and constipation; some drooped their heads and refused to eat while others would eat; no vomit-

DISEASES OF DOMESTIC ANIMALS.
SWINE.

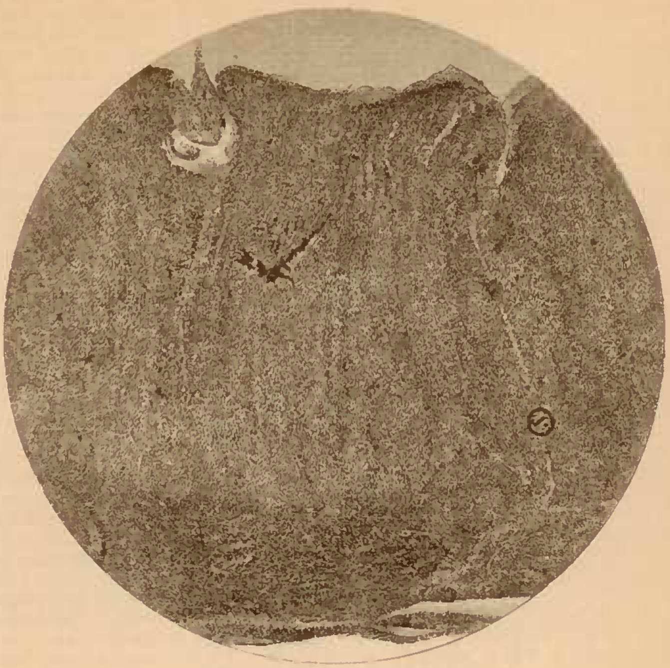


Fig. 1

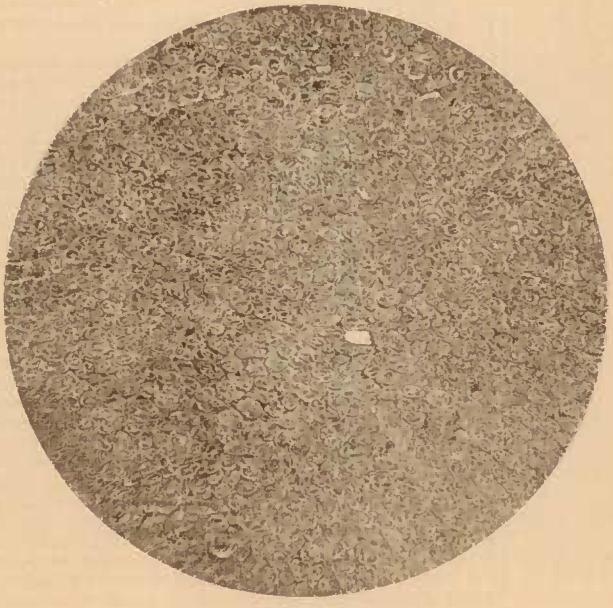


Fig. 2

Fig. 3

Fig. 4

A. Hoen & Co. Pat. Lithocaustic. Balto.

Report Commissioner of Agriculture for 1877. Plate III

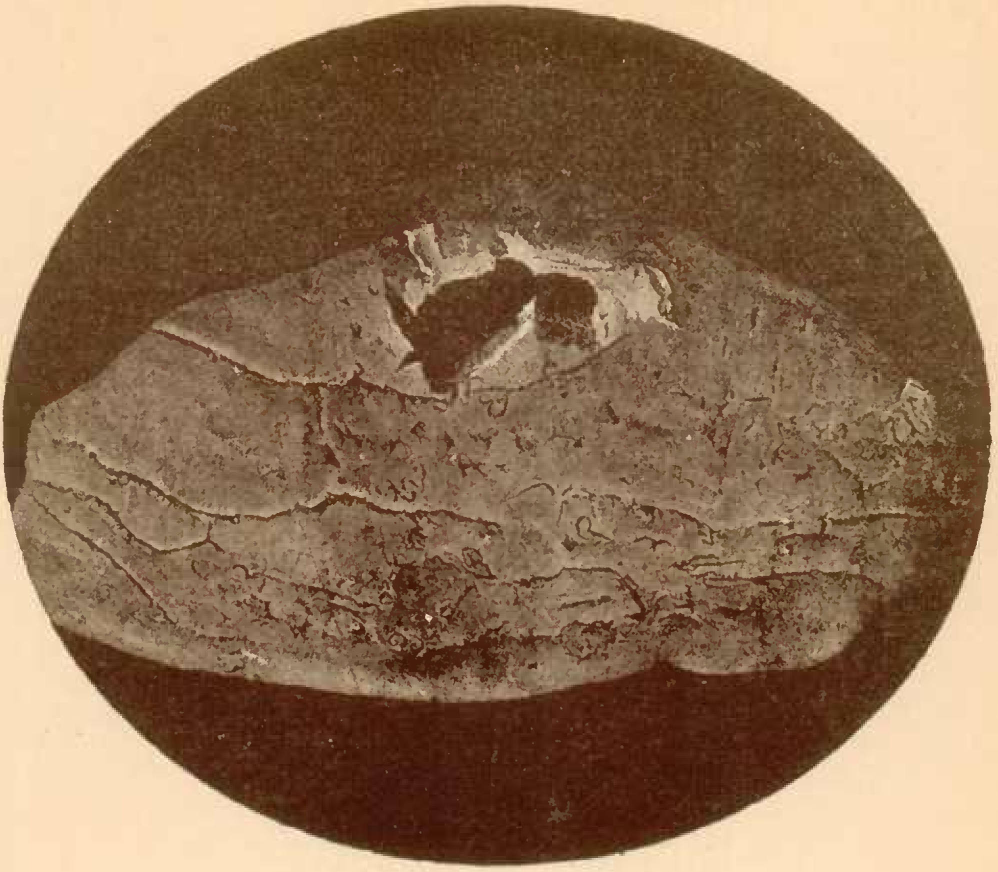


Fig 5

Fig 6

A. Hoen & Co. Lit. Lithocaustic. Balto.

DISEASES OF DOMESTIC ANIMALS.

SWINE.

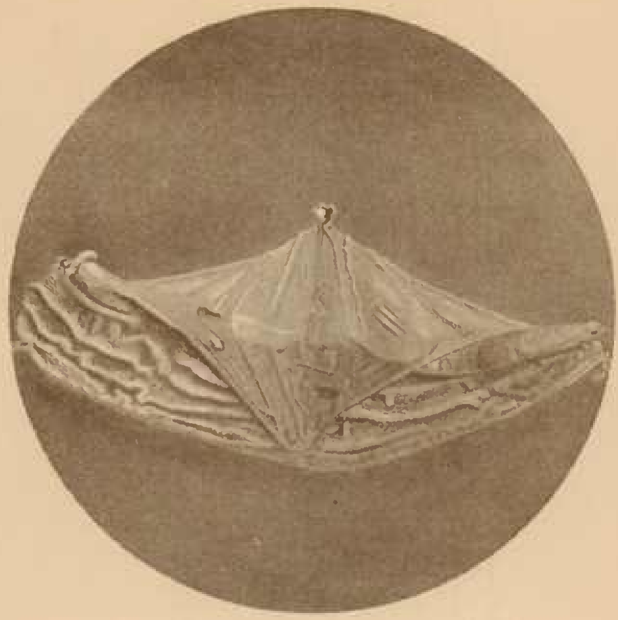


Fig. 7

Fig. 8

Report Commissioner of Agriculture for 1877.

Plate V

Fig. 9

Fig. 10

A. Hoen & Co. Lith. Lithocaustic Balto.

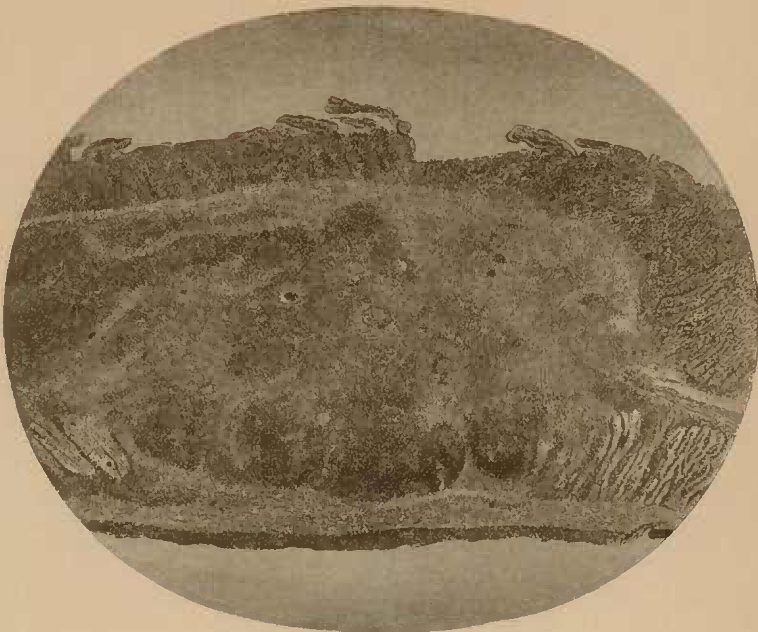


Fig. 11

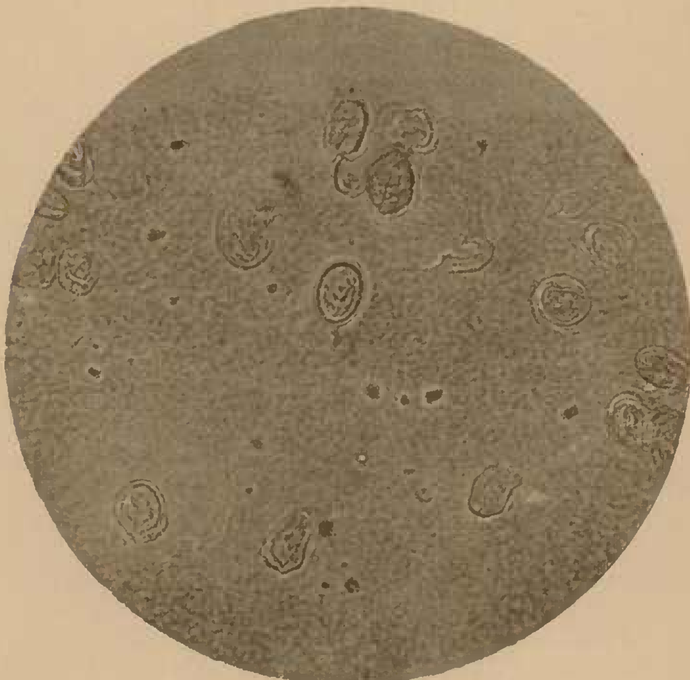


Fig. 13

A. Hoen & Co. Pat. Lithocaustic Balto.

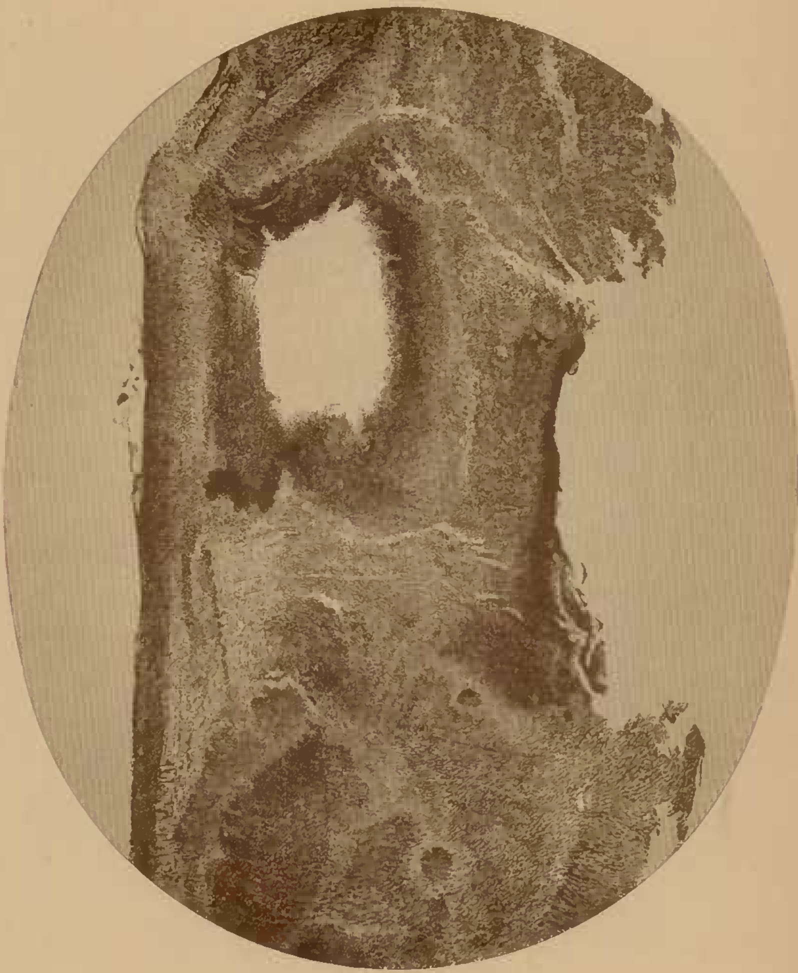


Fig.12

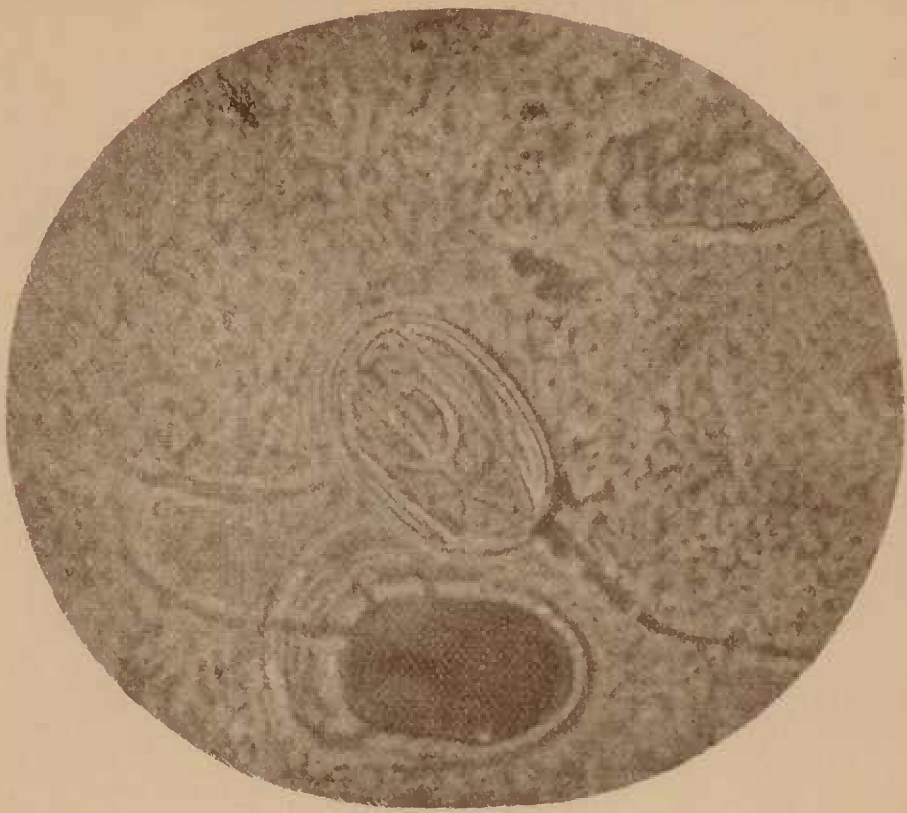


Fig. 14

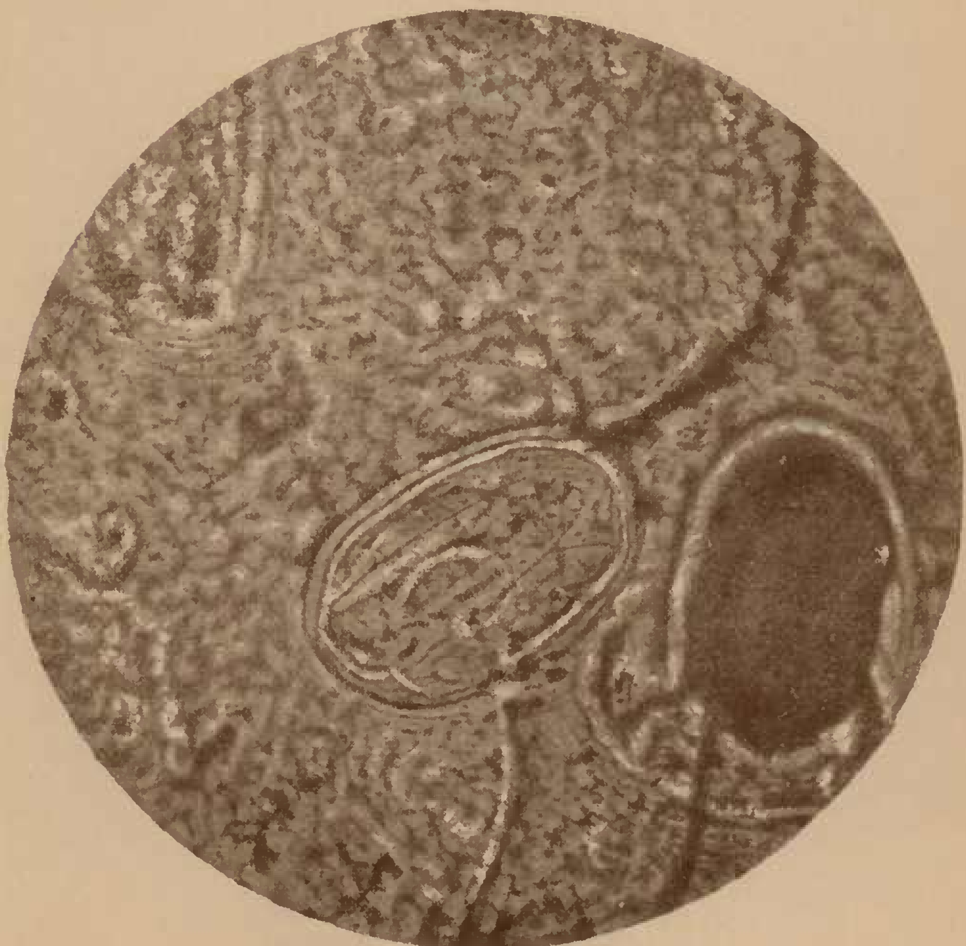


Fig. 15

A. Hoen & Co. Pat. Lithocaustic Balto.

Fig.16

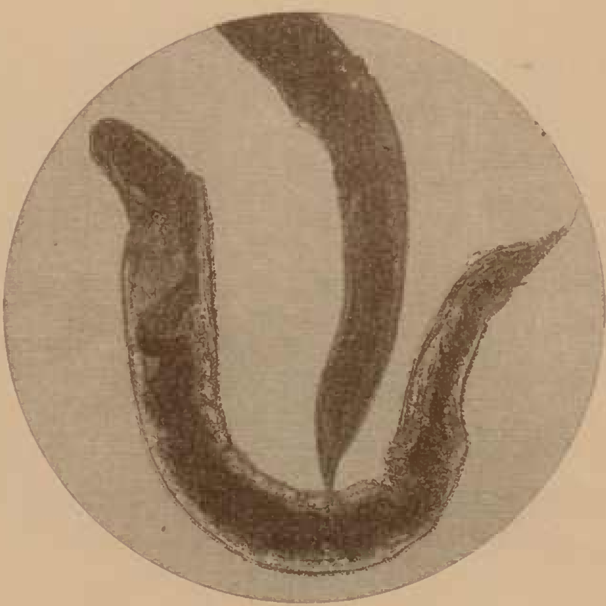


Fig.17

A. Hoen & Co. Lith. Lithocaustic. Balto.

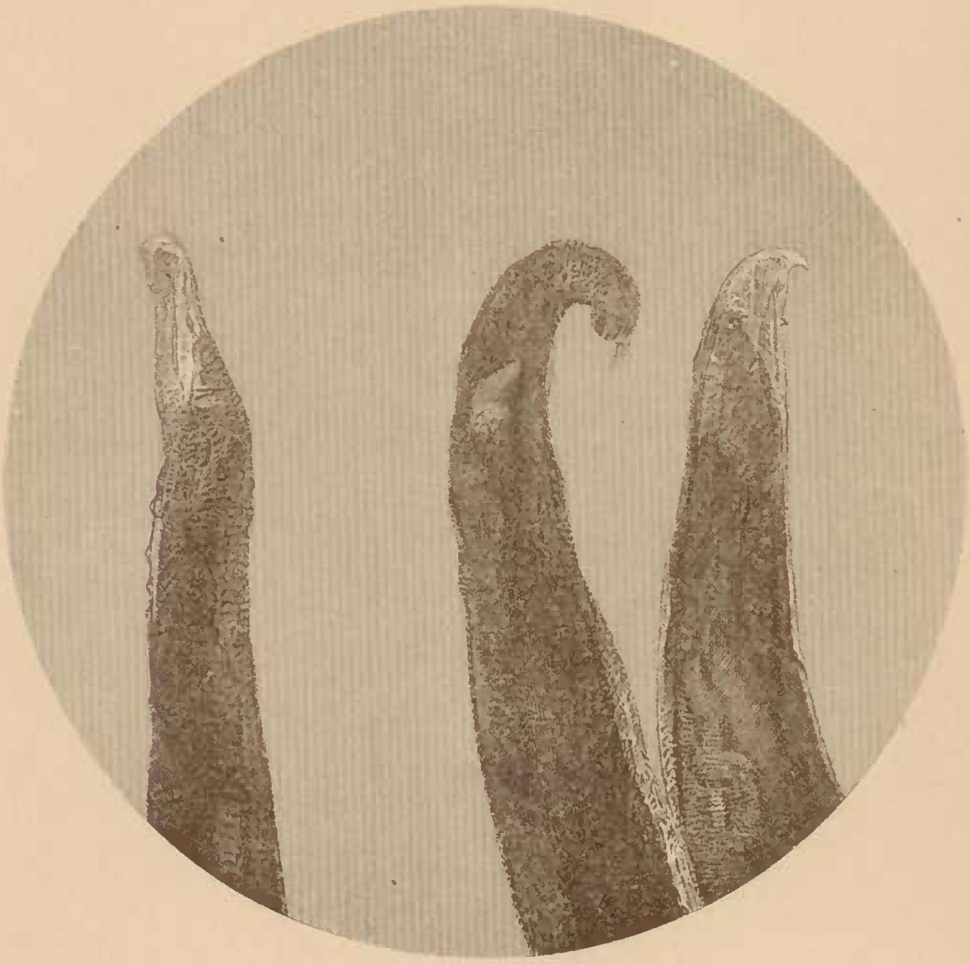


Fig.18

A.Hoen & Co.Pat.Lithocaustic Balto.

ing, no cough; high fever, swelled ears, skin reddened, black spots on them. They generally died in thirty-six hours from the time of seizure. Six or eight of those afflicted recovered, but they lost patches of hair from the body, and the skin cracked open in places. This herd was broken up into small lots, and was confined to the narrow strip of beach immediately on the ocean below life station No. 2. Those that recovered were worthless. No *post-mortem* examinations were held.

The miller for Mr. N. W. Forbes lost nine out of sixteen head. The temperature of one that had been sick a week was 103°. Small extravasations of blood appeared under the skin and in all the flexures of the limbs and about the ears. It was eating, and seemed pretty comfortable.

Mr. Jonathan Woodhouse, near the beach, lost twenty-five out of forty head. His breeding-sows all died. All his animals had the disease, and all his shoats died. The appearances were the same as in the above. Mr. Early Eden lost twenty out of eighty head. They were fat and in good order. Mr. Flannagan lost fifteen out of twenty.

Mr. Thomas Hendley, two and a half miles from the court-house, lost six pigs. Prior to my visit a six-year old sow was taken with purging, and was quite ill for two weeks, but began to mend slowly and finally recovered. The others were attacked with purging and then vomiting, and died soon after they commenced vomiting.

At the time of my arrival there were three sick. One of them, a nine months' old bluish-white sow, had refused to eat for two days. She was constipated, feverish, splotched with reddish spots over her belly and inside of her forelegs and thighs. Her temperature during the morning and evening was as follows: Morning, 105°, 104½°, 106°, 104½°; evening, 104½°, 104°, 105½°, 105°. Having lost a litter of pigs, she was turned out into a grass-plat, where she began eating and seemed in a fair way of recovery when last observed. The second one, a white sow of the same age, just sickening, presented some pale pink spots on her belly. Her temperature, taken under the tongue, was as follows: Morning, 102°, 103°, 103½°, 103°; evening, 102°, 103°, 104°, 102½°. It remained about the same during my stay.

I will now ask the reader to recall to his mind the description of the stock-yard given in describing the third case. A black shoat of the same age of those in the fattening-pen refused to eat; moped in the bedding, hung its head, and seemed quite sick. After two or three days it was taken from the fattening-pen and put in the little triangular pen described in Diagram No. 1, marked x. It had been there some time before my arrival, in about the same condition as when taken out of the pen. On my last visit to the place I killed this pig, and found the brain and nasal cavity healthy; tongue natural and healthy, except a slight elevation of the papillæ toward its point; chest, heart, and pericardium healthy, but a small quantity of serum in the pericardium. The lungs were congested, and the entire surface looked redder than normal. In two places there were distinctly circumscribed lilac discolorations of the lung surface, about the size of a quarter of a dollar. This portion of the lung was more inelastic to the feel than the rest of the lung tissue; under the microscope it showed free blood corpuscles in the intercellular substance and fibrous clots in the larger bronchioles. These also contained free blood corpuscles. The air-vesicles were still pervious to air. The pulmonary pleura over these spots had a glistening, opaline tint. The costal pleura was not inflamed, and there was no fluid in the pleural sac. The diaphragm showed on its pleural surface some few points about the size of a large pin-head, that looked like hemorrhage.

The abdomen presented a singular appearance. "Every thing in it was," in Mr. Hendley's language, "glued together, just as though a pot of glue had been poured in it." The adhesions were not old enough to be tough, and upon separating them there seemed to be nothing peculiarly noticeable. The liver was of a deeper color than natural, and the gall-bladder contained a small quantity of thick, dark bile. The spleen was darker than normal. The pancreas was natural and so were the kidneys, except for a few hemorrhagic spots on them. The capsule separated a little easier than it normally should. The bladder was empty. The stomach was large and full of food. The small intestines were empty; the larger was full of dried fecal matter. The mesenteric glands were somewhat enlarged, and some few of them rather dark, as were one or two of the iliac lymphatic glands. The entire peritoneum was reddened, as might have been expected. Upon opening the stomach and intestines I found them reddened, and here and there over their surface were curious abrasions of the mucus membrane. These places varied in size from a small pin-head to that of a split pea. Some of them looked as though of recent origin, while others were healing. I present herewith photo-micrographs of a section through one of these spots, which seems to be clearly an erosion or eating out of the substance of the organ from within. There was not observed such evidence of inflammatory action as would have led to the loss of substance by degeneration of inflamed cells. Figure 1, Pl. I, is a photograph of one of such erosions, the section being made in a line with the gastric tubules. Figure 2, Pl. I, is a section across the line of the tubules from beneath such a spot. There is no deposit of the kind seen in typhoid fever patches, and there is no change but such as might be expected from the irritation set up.

Figures 3 and 4, Pl. II, exhibit a worm found in great numbers on the coat of the

stomach and small intestines, as seen in Fig. 5, Pl. III. Fig. 6, Pl. III, shows one of these worms just escaping from the wall of the stomach. This pig was black, and therefore I was unable to see any eruption that depended for notice upon color. I could observe nothing wrong with the skin, although I made most careful search.

Mr. N. H. Capps lost thirty out of forty head. Of these all but three were three months old; two were yearlings. A three months' old pig died just before my arrival. The symptoms of those that he had lost were about the same as those that had died on Mr. Malbone's farm adjoining. The *post-mortem* appearances of Capps's pig were as follows: It was an under-sized three-months-old black pig, and was ill for two months. No history of the disease was given except that the pig had been lagging behind the others when called up to feed. The brain and nasal cavity were found healthy, tongue furred, lungs ecchymosed in minute spots that seemed to be on the surface of the lung tissue; pleura, heart, and pericardium healthy; entire contents of the cavity of the abdomen most intensely injected; mesentery showed every vessel; liver dark, almost black, with a curious play of iris colors over it; spleen long, thin, and dark; kidneys presented minute spots of hemorrhage; pancreas shrunk; bladder empty; stomach contained very little food, and was congested and covered with thick mucus; small intestines were covered with a viscid catarrhal material. I noticed nothing like ulceration in this case, nor did I notice any cicatrices of former ulcers. The large intestine was filled with dry feces.

Mr. N. L. Williams lost twenty out of fifty-five head. The disease was prevalent among his hogs when I visited his place. I killed a three months' old pig that had been sick ten days, and found the brain and nasal cavity healthy; tongue clean; papillæ prominent over the entire surface; lungs mottled with the peculiar lilac or reddish brown discoloration noted in the previous cases, and presenting the same appearances under the microscope; pleura, heart, and pericardium healthy; liver rather large and dark colored; gall-bladder full of limpid, green bile. The stomach was intensly congested, the redness showing through and involving to some extent the peritoneal coat. Its surface was literally alive with small worms, which resembled the one shown in the description of Hendley's pig. The small intestine was empty and contained a few lumbricoid worms; the large intestine was full of dry, lumpy fecal matter; the mesenteric glands were all enlarged, some of them notably so; the peritoneum was not inflamed; the kidneys were rather large and dark; the capsules came off rather easier than they should do; the bladder was empty; pancreas natural; spleen a little large and dark. Upon a careful examination of the piece of small intestine which I selected for examination with the microscope, I found one of the same kind of small worms embedded in the fold of the mesentery as shown in photograph, Fig. 7, Pl. IV. The eruption on the skin was very faint.

During the summer Mr. Sykes had lost nearly all of his hogs by the disease, and when I visted his place I found one black pig about five months old that had been sick about a month. It was very lean and scarcely able to walk. It would eat ravenously whenever fed, but seemed to get poorer every day. Indeed, when I made a remark about its appetite, Mr. Sykes said: "Doctor, if you don't kill him he will try to live long enough to eat the last ear of corn on the place, and then die." Upon *post-mortem* examination I found everything about the head natural. The lungs were mottled, as usual, with the same colored marking, and in one place there was what seemed to be a sort of tubercular infiltration into its substance of about the size of a large Lima bean. Under the microscope this appeared to be lung tissue condensed, infiltrated with amorphous granular material. Scarcely a trace of its original structure remained. It was filled with larvæ of a worm, as shown by the accompanying photographs, which represent the appearances found in different sections. The heart and pleura were normal. Everything in the cavity of the abdomen was glued together with old adhesions. Large spots of blood in various places, varying in size from a pin-head to a shilling, and in age from those of evidently recent date to brownish stains where there was nothing but crystals of hematoidine remaining. Some of these crystals were perfectly exquisite in shape and color. The stomach was thickened in all its coats, inflamed and reddened, and covered with innumerable erosions and cicatrices of former erosions, alive with small worms, like those in the previous cases; small intestine empty, reddened, thickened, and scarred throughout its entire length; the large intestine full as usual; liver almost black and rather small; gall-bladder nearly empty; kidneys large, pale, and capsules loose upon them; bladder nearly empty; skin black. There were many spots that had a mangy look and were devoid of hair. The temperature of the animal when killed was 102$\frac{3}{4}$°.

With the exception of severe coughing, the previous history of this case was the same as usual—alternations of constipation and diarrhea, gradual impairment of strength, and loss of perfect control over the hind quarters. The animal was off its feed three or four days. The balance of the stock had died from about the same disease that seemed to ail this one. Some had severe eruption; some were constipated, and others had diarrhea; some lingered ten days or a week, and others would die before it was discovered that they were sick; some would refuse to eat, and others would die almost in the act of eating.

Just before my departure I heard that there was a pig sick at a place called Brown's Store, and went to see it. I found a small shoat, about two months old, which had been sick only four days. It was quite wild, and the chasing of it around the yard to catch it killed it. I opened it, and found the lungs in a state of acute inflammation. Under the microscope the inflammatory changes seemed to be confined to the intervesicular spaces. The air-vesicles were empty, but the lines dividing them were thickened. There were comparatively large areas that were filled with red and white blood-corpuscles and granular matter. Some of the medium-sized bronchial tubes leading to these affected spots were plugged up with fibrilla of lymph, blood-corpuscles, and the ciliated epithelium of the tube-walls. The liver, spleen, pancreas, and bladder were healthy. The stomach and small intestines were very little redder than normal. The inner surface of the stomach was eroded in few places, and the same worms described in the other cases were found imbedded in the stomach wall. There were very few of these in the small intestine. The kidney was found covered with large spots of freshly extravasated blood, which was confined to the investing capsule and did not extend at all to the substance of the organ. The pig was white, and there were several spots of the eruption clearly visible on the belly and inside of the fore legs. The temperature of the pig when it died was 104°. It had not fallen away much in flesh, and was in fair order.

James McAlpin, whose stock has been mentioned in a former portion of this article, had a herd of one hundred and twenty head, and of these he lost eighty during August and September. He had a nine-months-old black-and-white sow quite ill with the disease, which I killed for the purpose of examination. The hog was quite well grown and not much reduced in flesh. The remainder of Mr. McAlpin's herd were in a pea and potato patch, and were in very good order, but, with few exceptions, seemed restless and uncomfortable. They would root up a potato from the bed, walk around with it in their mouths, take one or two bites, and drop it, showing that they were all more or less off their feed. The hog I killed was restless, and moved about from place to place to find a cool spot on which to lie down. When reclining it would extend its legs so as to have as great a surface of its belly as possible come in contact with the earth. It breathed hard and grunted and moaned continually; its skin was decidedly mottled on the white places on its belly; its hair in many places was turned in the wrong direction; its eyes were projecting, red, and staring; its abdomen was not swelled. Upon opening the head I found the brain and its meninges considerably injected, but there was no effusion either in the ventricles or outside the brain. The nasal cavity was healthy; tongue normal; the pleura, pericardium, and heart were healthy; the lungs were congested, and looked in places as though they had been pierced with a needle beneath the pleura. The liver was large and light-colored; there was a cyst in one of the small lobes, which proved to be an echinococcus cyst. The spleen, pancreas, and kidneys were normal. There were no extravasations of blood anywhere in the peritoneum. The mesenteric glands were enlarged and of a pinker color than natural. The stomach was full of food; the small intestine was empty; the large intestine was full of dry fecal matter. The stomach was eroded and swollen toward its pyloric end; the small intestines showed spots of similar erosion. A lumbricoid worm was found fast to a portion of the small intestines, and upon cutting it open it was found that the worm had nearly perforated the bowel. The tumefaction of the interior coat of the stomach near the pylorus seemed to have prevented any of the food from passing down into the bowels. The same small worms were found in almost countless numbers upon the stomach.

The disease had prevailed among Mr. John Woodhouse's hogs early in the summer, and out of over one hundred and twenty-five head he had lost ninety-five. But two or three that had the disease recovered. He was in hopes that he could fatten those remaining for his winter pork. The evening before my departure he sent me word that the disease had broken out again. On my arrival at his place I found several ailing, and from among them I killed two. The first was a three months' old black-and-white sow. The only peculiarity in this case was large extravasations of blood around the kidneys, which, as usual, was contained in the capsule and did not extend into the substance of the organ.

In the second case, which was about eight months old, the spots of eruption were tolerably well marked. The lungs were healthy in one case and only moderately injected in the other. The temperature of both animals was about the same, viz., 103°. I found a solitary gland somewhat open and enlarged; this, however, did not seem to affect its internal structure. The stomachs of both animals were swarming with small worms. The disease had been off the place for several months when it reappeared.

The above is a short history of the disease and cases that came under my observation. The *post-mortem* examinations were made on subjects that embodied fair samples of every phase of the disease, save that of extreme malignancy. These cases were pronounced by the farmers to be of about the same intensity and general character as that which had so devastated their herds, and the animals that I killed were pronounced by their owners, from their previous experience, "fatally ill."

Now, what is the conclusion to be drawn from the observations herein recorded? Is the disease a fever, such as essential fever, as the names *charbonneuse*, typhus, typhoid, and enteric would imply; such a disease as is contagious or infectious by the imbibition by a sound animal of some specific exhalation generated by the operation of a specific poison in a sick or dead animal? Almost all observers have relinquished the idea of classing this disorder among the eruptive, febrile disorders, to which class belong measles, scarlet-fever, small-pox, &c., in the human family, principally because the so-called eruption is hemorrhagic in its character, and also from the fact that in many fatal cases (much too large a proportion of cases if this disease were a true eruptive fever) there is no eruption beyond a general reddening of the skin, which is fairly attributable to the high temperature.

There is, however, one point in favor of classing this disease with exanthematous fevers, and that is, that those animals which survive the first onslaught of the disease, if they have had the eruption, shed their hair and lose the outer coating or epidermal layer of the skin. We will, however, revert to this point again.

The constancy of the lesions or loss of substance in the stomach and bowels, and the frequent occurrence of the eruption, have been relied on to class this malady with the typhoid-fever type of diseases. But the eruption is in no wise like the typhoid-fever rash in man, and the nature of the intestinal lesions is altogether and essentially different. In typhoid fever in man we have a disease which is characterized by an actual change in the cell elements composing certain glands of the intestine. There is a deposit in the substance of the gland called the typhoid deposit. This material as the disease progresses softens, and in disintegrating injures the surrounding gland and visceral tissue. Certain blood changes, engendered by the poison of the disease, diminishes the power of resistance to this encroachment of the destructive changes, and we have as a result a prolonged and oftentimes fatal disease.

The first point of dissimilarity between the typhoid fever of man and the hog distemper is in the fact that the "ulceration" of the stomach and bowel is not only not confined to the glandular structure of the intestine, but shows no election or preference therefor; and further, the ulceration is, in the first stage of the trouble, not an ulceration or loss of substance by inflammation or softening tissues, but an erosion or scraping, or eating out or away of the substance of the stomach or intestine. There is no deposit within or upon the wall of the intestine which, taking on softening, occasions a loss of substance. The damage is done evidently by something within. I think this is clearly shown by the photograph (Fig. 1, Pl. I), which shows such recent erosions. The surface of the stomach from which these sections were taken was intensely red and congested, but the inflammation had not lasted for a sufficiently long time to produce permanent changes, as is clearly evinced by the regularity and clearness of the outline of the gastric tubules up to and around the eroded places, and more clearly demonstrated by the cross-sections of the gastric tubules taken immediately under one of these recent erosions (Fig. 8, Pl. IV).

A clear evidence of this is furnished by Fig. 9, Pl. V, which is from a section through one of the older erosions. Here the changes produced by prolongation of the irritation are clearly visible in the destruction of the outline of the gastric tubules for some distance from the inner surface, but lower down they seem to be comparatively intact.

Again, a reference to the *post-mortem* examinations will show three cases of general peritonitis that reached the extent of forming adhesions. This is a singular feature, in view of the fact that the damage done to the bowel and stomach was confined, in its earlier stages at least, to the inner surface, and did not start at some distance from the surface as in typhoid fever, destroying in all directions until opening into the bowel, when the tendency of the destructive action seems to have changed to spreading on the surface, and is still confined as a rule to the gland tissue. The peritonitis is a result of perforation, and this occurs too often when the character and gravity of the lesion in this disease is taken into consideration, unless there are some other determining causes to this result.

In the small intestine of one of the pigs killed at Mr. Woodhouse's I found one of the solitary glands inflamed, enlarged, and open, and I made a number of careful sections through it. Figs. 10, Pl. V, 11, Pl. VI, and 12, Pl. VII, show the open cavity of the gland with its inner surface inflamed and undergoing degenerative change. Fig. 11, Pl. VI, (a section through the tissue of the gland) shows that the main body of the gland substance was not so materially involved in the inflammatory process as to destroy the bold outline of its parts. Fig. 12 is a section at right angles to the former sections, showing the surface of the gland eroded and the open cavity of the gland covered by a softened layer. Between the upper inflamed surface and the lower coats is shown a bridge of gland tissue in comparatively good condition. I think that the changes observed here were due to the inflammatory processes, which had their origin in the gland substance. It would appear, then, that while there is gastric and intestinal irritation, erosion, and ulceration, these are not of a character in any wise similar to those pertaining to typhoid fever as we know it in man.

I will now call attention to the persistent appearance of inflammation of a most

peculiar character in the lung-tissue. The pig at Brown's Store, which died from over-exertion in endeavoring to get away from us, presented a lung completely engorged and inflamed in every part, and a large, compact, fibrinous clot in the heart. As may be remembered, the microscope located the trouble in this lung in the interstitial tissue between the air-vesicles. The air-vesicles, to a great extent, were found devoid of any of the products of inflammation, and if they had not been rendered comparatively useless by the tumid and inelastic condition of the tissues between them, could, as far as any damage to them was concerned, have carried on their functions. This appearance of an entire lung acutely inflamed must be studied by the other cases where the lungs had been involved. Almost all the other cases showed small, distinctly circumscribed patches of what, under the microscope, was clearly seen to have been a similar affection.

This inflammation of the lung differs from ordinary inflammation of the lung or pneumonia just as clearly as the inflammation in the bowel differs from the inflammation of typhoid fever, viz: By the remarkable manner in which the inflammation is outlined and confined—lung tissue in the condition of acute inflammation abuts right against tissue which is apparently not affected at all.

It appears to me that a solution of this phenomenon can be found by the portion of lung examined in Sykes's and Woodhouses' pigs, of which I have presented photographs (Figs. 13, 14, and 15, Pls. VI and VIII) showing the larvæ or eggs of a worm scattered through the tissue. The patches of circumscribed inflammation could be, and most likely were produced by worms perforating the tissue in all directions, depositing their larvæ, or by worms hatched out of these larvæ migrating to other portions of the body. The peculiar characteristics of this inflammation could be accounted for in this way satisfactorily, and in no other that I can suggest.

[Since writing the above I have found a patch of consolidated lung in one of the specimens taken from the larger of the two pigs killed at Mr. John Woodhouse's place, and I submit herewith a photograph of the same (Fig. 16, Pl. IX). This pig, as will be remembered, had the disease during its former appearance upon the place, and apparently had recovered.]

I noticed no other changes of moment in any of the other viscera, or at least none that were constant. The spleen did not seem to suffer in this disease as in most of the blood diseases, or diseases that are developed by contagion. In examining these cases one is struck with the curiously hap-hazard character of the damage done. The amount of damage inflicted in many instances does not seem to account for the rapid death of the animal. This fact was long ago recognized, and it was to account for the fatal character of the disease that the charbon or *charbonneuse* element, or the idea of a separate, distinct, essential fever poison, was invoked—such a poison or ferment as would so act on the juices of the body as to unfit them to subserve the purposes of life.

Remembering the fact stated in the earlier part of this article, that the poison of this disease is shown by long and careful observation to be hurtful to the pig alone, let us see what effect its absorption in large quantities into their bodies will have upon the health of swine. While no instance of the kind came under my own observation, I was informed by many of the farmers that pigs would eat the carcasses of those dying of the disease and not be incommoded thereby; or, to be more precise, they do not seem to be taken with the disease any sooner, more surely, or more severely after such eating. The experience of these farmers is borne out by numberless other observers. Among other references, I will quote again from the article in the Saint Louis Globe-Democrat.

Mr. Jos. Hurst, of Ford county, Missouri, says: "I have heard it claimed as a remedy for the swine to eat the dead carcasses."

Mr. George Hunter, Macoupin county, Illinois, says: "The carcasses of cholera hogs in our neighborhood are imperfectly buried at best, and generally exposed wholly, and are habitually eaten by the hogs surviving."

Mr. J. C. Peak, Fayette county, Missouri, says: "The swine ate of those dying with the disease."

Mr. G. V. Brooks, Warren county, Missouri, speaking of the dead hogs, says: "Some are burned, and some are eaten by the live hogs but without injury."

These observations could be greatly multiplied. There is no doubt about the fact that the swine do eat the bodies of those dying of the disease, and there is equally little doubt that this eating produces no appreciable effect upon them; and I think there is equally little doubt that if there really was any such frightfully malignant virus existing in and causing this disease, the effects of a hearty meal of such material would be, at the least, apparent.

There can be no question of the existence of fever in the disease, as this is demonstrated by the temperature of the animals, rising to 105° in one case, and at McAlpin's to 107½°. Septic blood changes would account for this, but there is no such septic element about the disease.

I had a very interesting conversation with Mr. Foster, of Richardsville, Culpeper county, Virginia, about this disease. The immediate location is the rolling, hilly land on the first thirty miles of the Rappahannock River, above tide-water. The "hog

cholera," in an epizootic form, has never visited that district, "but hogs do get a disease from sleeping in dusty places and in old, musty straw-yards, or on old manure-heaps. They cough, wheeze, and sometimes purge and vomit, get red and sore on the skin, some of them almost turn black and seem to have intense fevers, lose all appetite and die rapidly, and those that recover never amount to much. Nothing seems to do them any good, and when once attacked with the disease they may as well be given up as lost." The observations of Mr. Foster are sustained by those of hog-raisers all over the country. In certain seasons and in certain locations the disease seems to be engendered by just the environment here described. Stress is laid on the dryness, dustiness, or mustiness of the bed, for close herding under other circumstances is not competent to produce this distemper.

C. Schmidt, V. S., Jesler, Kurhessen, a translation of whose article may be found in the Edinburg Vet. Review, vol. 5, pp. 60 *et seq.*, 1860, after saying "no evidence has been adduced to show that a contagion exists in this disease, but rather that it does not," and "the disease does spread by contagion," gives as the result of long, careful, and painstaking observation the opinion that the disease owes its origin to dusty, musty beds, ill feeding, sudden change of temperature, &c. After giving his reasons for taking it from the anthrax affections, he gives the name of typhus to the disease.

I have thus briefly reviewed some of the points that in my opinion go to disprove the theory that the disease is a malignant, contagious, essential fever, according to the opinions that obtain upon the subject in general pathology. I do not see any reason to deviate from these general principles in considering the disease of any particular animal. The nutritive changes that take place in the healthy tissues of all warm-blooded animals are governed by the same general laws, and, as far as we can judge, accord in the most minute particulars. It could not well be otherwise, when it is remembered that the ultimate cells of the different parts of the body are, in all warm-blooded animals, essentially alike. The proper nutritive change going on in these constitutes health, and prevented or perverted nutritive change constitutes disease. Disease in animals must be subject to the same general laws, modified, maybe, to a slight extent by habitat, food, mode of life, &c., as in man. Pneumonic lung in a horse, ox, or hog shows precisely the same tissue changes that characterize pneumonic lung in man. Disease is subject in all animals to the same laws of contagion and infection. A careful consideration of all the facts shown by the *post-mortem* examinations and the history of the disease here and elsewhere leads to the conclusion that the essential elements of a contagious, true fever disease are wanting in this case. There is no doubt but that while the disease is not in the sense generally understood to attach to the word contagious, yet the appearance of a case of the disorder in a drove is soon followed, as a rule, by more cases, and there would seem to be danger in allowing healthy stock to run with sick animals. Dr. Fletcher, in 1872, described a worm found in great numbers in swine dying in a cholera epizootic, and he thought it probable that the entozoa there found were the cause of the distemper. This idea, for some cause, did not obtain, and yet, from my own observations, I cannot doubt that the parasites found in such great numbers in all the swine examined by me must be connected with the disease. In giving this opinion it will be but right to consider for a moment whether the different symptoms of the disease can be accounted for under this hypothesis. As I have before said, the inflammation in the lungs can be so accounted for; and the occurrence of lobulated patches of severe inflammation immediately adjoining healthy, sound tissue can also be reasonably accounted for in this way. The peculiar appearances in the internal organs, where lesions occur, are just those that would be expected by the traversing of their substance by such entozoa as those shown. The character of the inflammation in the stomach can be attributed to the effects of the perforation of its walls as shown in Fig. 6, Pl. III, where the worm escaping from the walls of the stomach is shown. Fig. 7, Pl. IV, shows the worm escaping from the small intestines. These lesions would also give a fair presumption of peritonitis. The frequent occurrence of this trouble may thus be accounted for in a gastro-intestinal inflammation, which we could not expect to so determine in so short a time. The skin lesions can be accounted for in either of two ways, in accordance with known and accepted opinions on such subjects. First, it may be sympathetic, for in man certain eruptions are known to accompany certain verminous diseases. Lumbricoid worms frequently cause a rash and a pustular and furincular disorder, as has been noticed as sometimes accompanying the trichina disease.

Second. It may, and probably is, occasioned by the traversing of the cutaneous tissues by these entozoa, which give rise to minute hemorrhage. The fever can be accounted for, just as the fever of trichinosis, by irritation from the boring and scraping of these little animals in all parts of the body.

Certain entozoa are known and admitted by observers to produce two of the principal lesions in this disease. The *strongylus bronchialis* (Cobbold), or *filiaria bronchialis* (Owen's Rudolphi Leidy), are known to produce inflamation of the lung, palpitation of the heart, and death from symptoms resembling pneumonia, or from just such an emaciation as seen in Capp's and Sykes' pigs. The *stephanurus dentatus* (Diesing), or

sclerostoma pinguicola (Verril), has been acknowledged to produce the staring coat, plaintive moanings, partial paralysis of the hind quarters, diarrhea or constipation, perforation of intestine, and transmatic irritation, peritonitis, and death by its boring of the abdominal viscera, in apparently the same way as they die in this disease. A most singular feature in this connection is that these two worms were held by entozoologists to be identical, until Verril showed the difference between the two in 1874. It must be remembered that the history of the genesis of these minute animals, varying in length from one-third of an inch to one inch, with an average thickness of about the fiftieth of an inch or less, is not thoroughly and clearly known, and we do not know the varied forms that these animalcules may assume during their lives. The common tape-worm (*Tænia cœnurus*) has, during its life, six stages, viz:

1. Eggs in all shapes.
2. Six-hooked embryo.
3. Resting larva.
4. Immature tape-worm.
5. Strobilla, or sexually mature *Tænia solium*.
6. Proglottis, or free segment.

Some other entozoa have an almost equally varied career of existence technically called "alternate generation." Some entozoa infest and are viable in one animal or parts of an animal during one period of this alternate generation, and in another animal or part during another period. There may be, and no doubt are, forms of and habits in the lives of these animalcules that at present are unknown to us. Their ways of gaining access to the body are, to say the least, not all known. The absorption either of immature worms, their eggs, or other forms through the pores of the skin, as suggested by Frommer, and their subsequent development, may give rise to the peculiar skin appearance of the "cholera." The fact that certain localities, or certain conditions of dust, must, dryness, or moisture, seem to be able to give origin to the disease, would mean that the larva, eggs, or the worm in certain stages of its life may be preserved in such places and under such conditions for an indefinite period. Certain forms of disease in grain are verminous in their character, and what connection, if any, the feeding of corn has with outbreaks of the disease is a matter for observation. Certain it is that the well-known vagaries of the helminth or verminous lives will account for the wonderfully rapid spread of the disease in some instances, and the long period of its incubation, or its total lack of contagiousness in other cases; and it will explain the fact that swine may eat the bodies of those dying of the disease with apparent impunity.

In closing this portion of my investigation, I would say that, whether the verminous theory of this disease be correct or not, the opinions that at present obtain on the subject are erroneous, and we need more light on a subject that is so disastrous to our national wealth. This can only be obtained by searching for it in the habits of healthy and sick animals, and in the bodies of those that die of the disease. Supposing the theory of its verminous nature to be true, no possible idea of treatment or remedies can be suggested until something definite is known in regard to the life of the parasite causing the trouble.

The need for careful, painstaking investigation then becomes apparent. We want accurately collated facts, not theories, for a solution of the difficulties that seem to surround and prevent a clear understanding of this plague.

I embody in this report an excerpt from the letter of George F. McWhorter, esq., of Chickasaw, Colbert county, Alabama, which accompanied some worms sent to the Department of Agriculture, figures of which are appended marked 17 and 18, Pls. IX and X. Mr. McWhorter says:

"I send you in alcohol by to-day's mail a number of worms taken from the lungs and intestines of hogs that died during the epidemic last summer. This disease was called 'cholera' by farmers in this vicinity, a term, by the way, which is here used to cover 'all the ills that hogs are heir to.' These worms are from two different hogs several miles apart, showing the identity of the trouble.

"The small worms are from the alimentary canal, the larger ones mostly from the lungs, though nearly all the tissues were to some extent infested by them. Found the bowels constipated, notwithstanding the name applied to the disease, and filled with impacted feces. Mixed with the fecal matter and adhering to the walls of the canal were myriads of the small worms. *I saw no large worms in the bowels.* There were numbers of small inflamed points along the inner surface of the bowels, but no large patches of inflammation, and the larger worms were very numerous. The lung-tissue in places was entirely broken down, and the sounder portion riddled with worms. Next to the lungs and bowels the liver suffered most. The worms here were also larger than those in the bowels, from which I infer that the worm after being hatched in the bowel perforates it and penetrates the other tissues. Some fattening hogs, recently killed, show worms in the liver. As the hogs seemed tolerably healthy and with sound lungs, I doubt their identity with those sent you," &c.

The worms sent by Mr. McWhorter were in a condition that almost precluded any

examination of their interior by the microscope. They were brittle in texture and of a golden brown color, and looked as though they had been dried before they were put in alcohol. Yet they are more valuable than any opinions on the subject unsupported by material from diseased animals.

It will be noticed that I have carefully refrained from giving any name to the entozoa shown and spoken of in this paper. I hope, in as short a time as possible, to report the result of my investigations in this direction, and give all attainable information on the subject of the entozoa herein described, as being probably connected with this disease of swine.

The London Quarterly Journal of Microscopical Science for April, 1878, contains a brief paper read by Dr. E. Klein, F. R. S., before the Royal Society of England, at its meeting in February last, on the "Etiology of infectious diseases, with special reference to the doctrine of contagium vivum." The object of the paper was to bring before the Royal Society the results of an experimental inquiry (instituted at the request of the medical officer of the local government board) into the etiology of an infectious disease of the pig, known in this country and in Europe as hog plague, mal rouge, red soldier, malignant erysipelas, and also typhoid fever of the pig. Referring to the fact that both English and continental writers describe the disease as anthrax or splenic fever of the pig, the writer states that he will show conclusively in his report to the medical officer of the local government board that it is neither typhoid fever nor anthrax, but is an infectious disease of its own kind, which he proposes to call "infectious pneumo-enteritis of the pig" (*pneumo-enteritis contagiosa*).

Dr. Klein states that, like other infectious diseases, the "pneumo-enteritis" possesses an incubation period, followed by constitutional disturbance and certain anatomical changes. These changes are invariably affections of the lung, of the intestine, and of the lymphatic glands, and extend also to the organs of respiration and alimentation, and the inguinal and lumbar regions. In the lung the changes are those known to pathologists as lobular pneumonia. In the alimentary canal the mucus membrane of the large intestine is chiefly affected, being the seat of smaller or larger ulcerations. There is generally also inflammation of the serous membranes, especially the peritoneum, leading to an exudation of lymph into the serous cavity. The skin is occasionally affected with greater or smaller red patches. Hemorrhagic patches are also to be found in the lung and serous membranes, the endocard and the muscle of the heart, the mucus membrane of the intestine (especially duodenum and large intestine), the tongue, and occasionally in the liver and spleen, and but seldom in the skin and kidney. In anatomical respects, therefore, pneumo-enteritis undoubtedly bears a great resemblance to anthrax or splenic fever, to which pigs are known to be liable. The writer states that there exists, however, a marked difference between the two diseases as to the incubation period, the general pathology, and especially as to the anatomical character of the spleen and blood. In splenic fever the spleen, being the principal organ of the affection, is invariably enlarged, whereas in pneumo-enteritis it is only occasionally changed. The blood also presents entirely different characters in the two diseases. In pneumo-enteritis it is not different in any marked degree from normal blood, while in splenic fever it is of dark color, laky, and does not coagulate at all, or only imperfectly so. Again, the blood contains in splenic fever the now famous *Bacillus anthracis*, and hence its conspicuous infectious property, while in pneumo-enteritis the fresh blood does not, as a rule, contain any foreign matter, and in most instances does not possess any infectious property.

Dr. Klein says that another disease with which pneumo-enteritis bears

a great resemblance, on account of certain anatomical characters, viz., inflammation of serous membranes, lung, intestine, and lymphatic glands, hemorrhage in lung, serous membranes, endocard, muscle of heart, intestinal mucus membrane, and other organs, is specific septicæmia. The resemblance, however, is not considered greater than to splenic fever, although the differences are not less well defined. In addition to others, there is this great distinction, viz., in pneumo-enteritis the contagion spreads by simple cohabitation and through the air, which it never does in septicæmia, as in this the virus always requires a broken surface through which to enter a healthy individual. In splenic fever the period of incubation ranges from between a few hours to several days, while in pneumo-enteritis it varies from two to five days and more. Splenic fever is easily transmissible to man and the domestic animals, whereas the transmissibility of pneumo-enteritis is much more limited.

Pneumo-enteritis is occasionally described as malignant erysipelas (*mal rouge*, red soldier), but the writer regards this as inadmissible, as the affection of the skin in the former is a very inconstant symptom, and in milder forms of the disease is invariably absent. More recently the disease has been regarded as typhoid fever of the pig, but from a purely anatomical point of view the resemblance between real—*i. e.*, human—typhoid fever and pneumo-enteritis is very slight indeed; so slight, in fact, says Dr. Klein, that to mention it requires a total oversight of some of the most prominent symptoms, *e. g.*, inflammation of lung and serous membranes, enlargement of inguinal, lumbar, and bronchial lymphatic glands, hemorrhages in endocard and muscle of the heart in pneumo-enteritis on the one hand, and swelling and ulceration of the lymphatic glands of the small intestine, swelling and inflammation of the spleen, in real typhoid fever on the other hand. The resemblance seems to be limited solely to the fact that in both diseases there occurs ulceration in the intestine; but the distribution, nature, and the development of these ulcerations are totally different in the two maladies.

The character and results of Dr. Klien's experiments are given in his own language, as follows:

1. Experiments * showing that the fresh blood of diseased animals does not, as a rule, contain the virus, as it fails to produce the disease when introduced into a healthy animal.

Four animals were inoculated (at different times) with fresh blood of diseased animals. They remained healthy. When subsequently inoculated with virus-containing matter they became smitten with the disease. In a fifth instance, however, fresh blood did produce infection; and this same blood proved active after having been kept sealed up in a capillary tube for several weeks. This blood was obtained from a very severe case, with copious peritoneal exudation, in which were found peculiar, abnormally large, coarsely granular cells. The same cells were also present in the blood; so that it appears probable that the blood became charged, by absorption during life, with matter from the peritoneal exudation. This latter always contains the virus in an active state.

2. Experiments showing that fluid as well as solid lymph of the diseased peritoneum contains the virus in a very active state.

Six successful inoculations with peritoneal exudations.

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* In all my experiments of inoculation the *materies morbi* was used in minimal doses—*i. e.*, a drop of fluid matter, or, in the case of solids, a particle of less than the size of a pin's head. In both cases the *materies morbi* was diluted or suspended respectively in a few minims of boiled saline solution of three-fourths per cent., in order to increase its bulk and thus to facilitate its introduction. The inoculation was invariably carried out by injection into the subcutaneous tissue by means of a fine canula of a hypodermic syringe, necessary care being taken that this had been previously thoroughly cleaned and disinfected. After and before inoculation the animals have always been kept isolated and in clean and disinfected places. In order to secure reliable results (viz., that the disease in a particular case was really a consequence of the inoculation and not of infection through other sources), care was taken that those who attended the isolated animals were not the carriers of infection.

There was no difference of activity to be noticed between fresh exudation and one that had been kept sealed up in a capillary tube for several weeks.

Solid lymph obtained from the peritoneal cavity of diseased animals, having been dried at a temperature of about 38° C., proves very active.

3. Experiments showing that parts of the diseased lung, ulcerated intestine, and also diseased spleen, contain the virus in an active state. Diseased parts of lung or intestine, dried in a temperature of about 38° C., retain their virulence unaltered.

In all cases of pneumo-enteritis the trachea as well as the bronchi contain frothy, blood-containing mucus matter, possessed of infectious property. It must therefore be supposed that the breath of a diseased animal is charged with the poison. On account of the diseased state of the intestine the dung is also to be regarded as infectious.

4. Experiments showing that infection is produced by cohabitation with a diseased animal, or by keeping healthy animals in a place whence a diseased animal had been removed.

5. Several experiments were made to see whether feeding healthy animals on matter obtained from the diseased organs (intestinal ulcers especially) produces the disease. The experiment was always attended with success if a lesion, *i. e.*, abrasion, existed in the mucus membrane of the mouth or pharynx. This was usually the case when the matter had to be introduced into the mouth while the animal was being held by assistants. There were, however, two cases which appear to prove that the disease cannot be produced by simple feeding. This was, unfortunately, at a time when I was not yet acquainted with the fact that in many animals the disease is of so mild a form that it can hardly be recognized in the living. I have not made any *post-mortem* examination of those two animals; but since then I have made two other experiments, in which the virus was brought directly into the stomach by means of an india-rubber tube introduced *per fauces et œsophagum*. In both these instances the animals became diseased, and their intestines were most conspicuously affected.

From the last three series of experiments we may conclude that the principal mode by which contagion of pneumo-enteritis is carried out is through the instrumentality of the air and of the food.

6. This series comprises experiments to prove that the virus can be cultivated artificially, *i. e.*, outside the body of an animal. In the case of splenic fever it has been successfully done by Dr. Koch. The experiments are seven in number: (*a*) Two refer to cultivations started with fluid peritoneal exudation; (*b*) In the five others the virus had been obtained by cultivation of dried lymph of the peritoneum of an animal suffering from the disease.

(*a*) The cultivation of the virus for the first two cases was carried out thus: Fluid peritoneal exudation of a diseased animal had been collected and sealed up on November 6, in a capillary glass tube. On the following day there was present a small clot, due to coagulation. A minute speck of this clot was removed with the point of a clean needle, and with it was inoculated a drop of fresh aqueous humor of a healthy rabbit. This drop had been placed in a thin covering-glass, which, after inoculation, was inverted over a small "cell," made by fixing a glass ring on an ordinary glass slide. The covering-glass was fastened on the glass ring by means of a thin layer of pure olive-oil. The preparation was then kept in the incubator for twenty-four hours at a temperature of 32° to 33° C. After this time it was used to inoculate a new drop of aqueous humor in a similar manner as the one just described. We will call this the second generation.

This new specimen was placed in the incubator and kept there at a temperature of 32° to 33° C. for further twenty-four hours. In the same manner a third generation was started by inoculating a fresh drop of aqueous humor. After having been kept in the incubator for several days, it was used to inoculate two animals at different times. Both animals became smitten with the disease.

(*b*) The other five experiments were carried out with virus cultivated from solid lymph of the peritoneum of a diseased animal. The lymph had been dried at 38° C. A small particle of dried lymph is crushed into fine powder; with a granule of this a drop of fresh aqueous humor is inoculated in the same manner as above described—first generation. After having been kept in the incubator for two or three days, at a temperature of 39° to 33° C., it is used to inoculate a second generation, care being taken to use a trace only of the fluid part and not to come in direct contact with the original granule, which may be still discerned in the preparation.

The specimen representing the second generation is kept in the incubator for a day or two. It is then used to inoculate a fresh preparation—third generation; and, finally, this is used for establishing a fourth generation. After having been kept in the incubator, a part of it is used for inoculating *two* animals, the inoculation being carried out at different times. Both these animals became smitten with the disease.

Another portion of this fourth generation was used to start a fifth generation, then a sixth, seventh, and an eighth generation. With this three animals were inoculated at different times. All three animals became diseased in due time.

In order to correctly interpret the results of this last (sixth) series of experiments, it is important to mention that inoculation with dried lymph, diluted far less than would correspond to the third generation in the last-named experiments, is followed by a negative result.

The microscopic examination of the cultivated liquids proves that these are the seat of the growth and development of a kind of bacterium, which has all the characters of *Bacillus subtilis* (Cohn). The bacillus in our case is a very fine and delicate rod, thinner than both that described by Professor Cohn in hay infusion and the *Bacillus anthracis* so thoroughly investigated by Dr. Koch. Our bacillus differs also in other respects from *Bacillus anthracis*, inasmuch as it possesses a moving stage; the *Bacillus anthracis* described by Dr. Koch is non-moving. Like *Bacillus subtilis* of hay and *Bacillus anthracis*, our bacillus grows under favorable conditions into long leptothrix-like filaments, which occasionally form more or less complex convolutions. In these filaments highly refractive spores make their appearance. These become free after the disintegration of the original filamentous matrix. The fully developed spores of our bacillus differ from those of hay bacillus and anthrax bacillus by being more distinctly cylindrical and much smaller. In the figures accompanying Dr. Koch's paper on *Bacillus anthracis* the spores are represented in many places as more or less spherical in shape. According to Professor Cohn (Bieträge zur Biologie der Pflanzen, II, 2, 1876, p. 264), the long diameter of the spores of bacillus of hay and also of anthrax, for both are identical in morphological respcets (l. c. p. 275), amounts to $0.0015—0.0022^{mm}$, or $\frac{15}{25000}$ to $\frac{22}{25000}$ of an inch; whereas the spores of our bacillus are little less than 0.0005^{mm}, or $\frac{1}{50000}$ of an inch in their long diameter.* At first I misinterpreted the spores, regarding them as a micrococci, and only after repeated observations have I succeeded in tracing them through their different stages of development.

After many failures, owing to the introduction and development of *Bacterium termo*, I succeeded at last in obtaining, already in the second generation of original virus, a pure crop of bacillus and its spores. With these I started several separate cultivations, in which the germination of the spores into delicate bacillus, the swarming stage, the rapid multiplication by division, their growth into long, apparently smooth filaments, and, under sufficient access of air, the formation of the bright cylindrical spores could be distinctly traced. (No other organisms appeared in these cultivations.) These were again used to inoculate other preparations of aqueous humor, and so on, until I succeeded in obtaining considerable quantities of liquid containing only bacillus and its spores. The last-named animals were infected with liquid of this kind.

Seeing that splenic fever, pneumo-enteritis, and specific septicæmia possess a great affinity in anatomical respects, and seeing that in splenic fever and pneumo-enteritis, the *materies morbi* is a definite species of bacillus—the difference of species being sufficiently great to account for the differences in the two diseases—we may with some probability expect that also the third of the group, viz., specific septicæmia, is due to a bacillus. This, however, remains to be demonstrated.

During a visit of the Commissioner of Agriculture to the annual fair at Saint Louis, in October last, he had several interviews with prominent Western stock-growers, who were in attendance upon and exhibitors at that exhibition, on the subject of the proper care of farm animals and of the treatment of the various diseases incident to them. These interviews were stenographically reported, and that portion relating to the diseases of swine is given below. Mr. Kidder, whose hogs had been

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* In convolutions of filaments the outlines of these latter become gradually lost after the spores are formed. The spores appear now to be embedded in a transparent gelatinous matrix. At the edges of such masses, or where they are in a sufficiently thin layer, the linear arrangement of the spores can be still recognized. But there is undoubtedly a transparent jelly present in these masses forming the ground substance for the spores and fibers. Professor Cohn mentions a similar jelly in convolutions of hay bacillus. I entirely differ from Dr. Koch with regard to the mode of germination of the spores of bacillus. He states that it is not the highly refractive spore which directly produces the bacillus, but that the hyaline gelatinous envelope surrounding each spore elongates so as to form the bacillus, while the bright spore-matter itself gradually diminishes and finally disappears. From *à priori* reason it is impossible to assume that this can be so, viz., that the gelatinous envelope should grow into the bacillus, for Cohn proved beyond doubt that in the case of hay bacillus the spores germinate even after having been exposed to boiling heat. Surely this gelatinous envelope, if living protoplasm, must become, under these conditions, deprived of its germinating power. Direct observations prove that in my case the spores possess another membrane within that gelatinous envelope, and during germination this inner membrane is broken at one pole and the contents of the spore protrudes and grows out as the bacillus.

afflicted with the disease generally known as cholera, gave the following description of it:

I have a friend who calls it stye-fever, which is somewhat similar to old-fashioned typhus fever. It is generated where large bodies of animals are kept. The hogs are affected in different ways; some are lame and some purge and vomit. There are hardly any two cases alike. I think the disease is caused by an air poison. In my efforts to save them, I would drench them and walk them around, and dose them sometimes with quinine and sometimes with calomel. I spent $30 last fall (1876) for medicines, but they did no good. I have a farm two miles distant from where I live. I drove all my hogs up there and they all recovered but one. The change of location seemed to dissipate the disease and my hogs have not been afflicted with it since. The hogs remained up there two months, when I brought them back to the home farm. During the time they were away (November and December) there had been freezing weather, and the germs of the disease were probably frozen out of the soil.

Another breeder said:

I doubt if the germ was in the soil, as it is no doubt an air poison. Prof. S. A. Knapp, of Vinton, Iowa, president of the Fine Stock-Breeders' Association, asked me this fall if my hogs had been afflicted with cholera. On answering that they had not, he desired to know what I would do if I found the disease among my hogs on my return home. I told him I should inquire the cause. I should inquire if they had been drinking bad water, or had been eating any vegetable matter that exhaled poison; and, if so, that I would take them out of that field and remove them to another part of the farm. If they had been feeding on corn, I would change their feed to oats. I would change both the feed and location of their sleeping apartments. I have been led to believe that the disease is caused by swarms of parasites in the system, or, if not entirely so, it is greatly aggravated by them. I would, therefore, in the first place, give them turpentine. It will not immediately throw them in a stupor. If it does not work so as to carry off the excrement, I would give them a second dose with charcoal. This will absorb the mucus and slime in the intestines. The worms are really knotted up in hard lumps there, and the turpentine will unknot and the carbon absorb them. A second dose of vermifuge or turpentine will generally carry off a large number of worms before they rally from the stupor caused by the first dose. I would give the charcoal to absorb the mucus, and if that did not effect a cure, I would give a box of concentrated lye in slops, and then turpentine to allay the inflammation. One box of concentrated lye is sufficient for a barrel of slop, and one teaspoonful of turpentine is sufficient for a dose for a pig. I give the turpentine in slop, and if they won't take it, I shut them in a dry lot and let them stay there until they get ready to take a drink. They are always feverish and thirsty when sick, and turpentine is one of the best remedies known for fevers. I have a dry lot for my hogs to run in. If my pen is not clean, I whitewash it and sprinkle it with carbolic acid. This is one of the best disinfectants in the world, and I sprinkle the hogs and pen with it once a week.

Dr. Stetson, of Illinois, was at my house in February. He is the most successful in his treatment of this disease of any man I know. He says a man can carry the disease on his feet from one pen to another. It breaks out in large bodies of hogs and soon becomes contagious. The longer it runs the more contagious it becomes, just as fevers rage and spread among the lower classes. It is a rare thing to hear of typhus fever in the houses of the upper circles until after it has become contagious.

I always go out in the mornings and look after my own hogs. If one is missing I look him up, and if he has the least symptom of sickness, I do not wait until he gets down; I take it in time, and give the animal simple remedies, such as you would give a child. If it is constipated, I give medicine to open its bowels. When a hog first rises in the morning it always, if well, evacuates its bowels. If there is any inward fever the animal is constipated, and the excrement consists of round black balls stuck together. If it is well, the evacuation is mealy and mushy; on the other hand, it consists of round, hard, dry balls. Then a change of diet is necessary, as is also something to loosen the animal's bowels.

Mr. L. M. Bonham said:

My experience has been similar, though we have not been troubled with cholera in our neighborhood. Our hogs seem to suffer more from colds than any other class of animals. This is, perhaps, because they are thin-haired. I was fattening fifty-five head last year, and on my return from the Centennial a cold sleet-storm came on. While on my way home I said to my son, "I will find half the hogs out of fix when I get home." I had left them in a clover-field, not expecting a storm so early as October. We had a freezing, sleety storm, and I found every pig ailing like people with colds. I asked the man what was the matter with the pigs, but he said he had not noticed anything unusual. They seemed to eat all right, but I could discover that they were

ailing—showing symptoms of cold; and I went to work that evening and gave them laxative bran mash, and the next evening I repeated it. I then gave them some copperas, salt, and ashes; all worm-destroyers. I mixed a bucketful of salt to a pound of copperas. When I can get charcoal I place it where my hogs will have free access to it.

Another breeder said:

I have used as a remedy for this disease three bushels of ashes, one-half bushel of slaked lime, one-half bushel of salt, ten pounds of copperas, and two or three pounds of bran. I mix this dry and put it in a trough. You would be astonished to see how much they will eat of it. If a hog is sick he will quit his ordinary feed and go straight to it, showing that he seems to crave some kind of mineral. It is good for fattening hogs and makes the skin glossy.

Mr. BONHAM said:

If anything is the matter with any one of my hogs, I take him out of the herd, where I can note the symptoms and the frequency of them; and as long as he is feverish I keep him away from the rest. A neighbor of mine had the intestines of some of his diseased hogs examined, and found them infested with parasites. The disease, I think, is the result of a cold, which is soon followed by a cough, thumps, and indications of fever. That has been my experience. The lungs, when the disease is far advanced, are filled with a mucus matter. During the early stages there is an irritated condition of the lungs. When a hog has the thumps he will lie quietly in the stye, but I do not think this is caused by a distention of the stomach.

Mr. CLARK said:

Professor Knapp gives it as his opinion that this inactive condition of the animal is a prime cause of indigestion. My own experience is that my best pig which lies in the pen is the first to have the thumps.

Mr. BONHAM said:

I think his lying in the pen is an indication that he is out of fix. If we will watch his condition carefully we will notice, two or three weeks before the thumps come on, that he has had a cold. If the animal eats heartily every day and takes cold, he will lose his appetite. On the first symptoms of a cold, therefore, he should have a change of feed. I have never had any trouble with the thumps when I have followed this treatment. A hog afflicted with the thumps is generally constipated, and the first thing I try to do is to bring about an action of the bowels. I have tried injections, but with not very satisfactory results. The animal may recover from an attack of this disease, but it will not have good growth for from four to six weeks, and will have to be fed carefully in order to bring it up to the standard. The well ones will get the lion's share, while the weaker ones will be crowded back.

I do not think that thumps is transferable or contagious, but I am of the opinion that cholera is. As an example, I will state what occurred to a gentleman living seven miles east of me, who lost eighty hogs with this disease. His next neighbor's herd was afflicted with the disease. Dr. Homer, of Ohio, told me that he went to examine this herd and asked all the questions he could think of in order to ascertain the origin of the disease. Among other things he wanted to know was whether these hogs had ever come in contact with other hogs. He was told that they had not, but his little son said: "Father, don't you remember there was a shoat from so-and-so's farm that got into our herd eight or ten days ago?" The man denied anything of the kind, but the doctor traced the matter up, and found that the shoat came from the farm where eighty hogs had been lost.

Mr. KIDDER said:

It often happens that hogs that die of disease are buried so lightly that the dogs have no difficulty in digging them up. They will take a piece of the carcass and carry it into a field where a herd of hogs are confined, and thus communicate the disease to them.

Mr. Bonham said that for that reason, whenever a hog dies on his farm, he burns the carcass.

CORRESPONDENCE SHOWING THE GENERAL PREVALENCE OF DISEASES AMONG SWINE.

ALABAMA.

Mr. GEORGE C. McWHORTER, Chickasaw, Colbert county, says:

I send you in alcohol, by to-day's mail, a number of worms taken from the lungs and intestines of hogs that died during the epidemic last summer. This disease was called cholera by farmers in this vicinity; a term, by the way, which is here used to cover "all the ills that hogs are heir to." These worms are from two different hogs, several miles apart, and show the identity of the trouble. The small worms are from the alimentary canal; the larger ones mostly from the lungs, although nearly all the tissues were to some extent infested with them. I found the bowels constipated, notwithstanding the name applied to the disease, and filled with impacted feces. Mixed with the fecal matter and adhering to the walls of the canal were myriads of the small worms. I saw no large worms in the bowels. There were numbers of small inflamed points along the inner surface of the bowels, but no large patches of inflammation. Perforations were perhaps made at these points.

The hogs had been troubled with persistent cough, which led me to examine the lungs carefully. Here were found great patches of inflammation, and the larger worms were very numerous. The lung tissue in places was entirely broken down and the sounder portions riddled with worms. Next to the lungs and bowels the liver suffered most. The worms here were also larger than those in the bowels, from which I infer that the worm, after being hatched in the bowel, perforates it and penetrates the other tissues. Some fattening hogs recently killed show worms in the liver; but as the hogs seemed tolerably healthy, with sound lungs, I doubt their identity with the ones sent you.

From what I have seen of the disease I make the following deductions:

1. The worms are hatched in the bowels.
2. They must be destroyed before they leave the bowels.
3. When the lung is perforated treatment is unavailing.
4. Almost all cases let alone prove fatal.

Treatment should be founded on these principles. I recommended calomel and arsenic to a number of farmers. Many hogs just taken recovered under this treatment, but nearly all the old cases died.

Mr. JOHN POWERS, Rutledge, Crenshaw county, says:

Hog-cholera, as it is generally known in this vicinity, prevails more or less every year. When attacked, the patient begins to droop, holds down its head, and is indifferent to eating or drinking. They seem to be affected with a kind of dysentery, with frequent small evacuations. The surface is warm, and there are occasional quiverings of the flesh. Occasionally they die almost instantly. *Post-mortem* examinations clearly show that indigestion prevails.

The fatality is about 50 per cent. of those attacked. Generally three-fourths of a herd will be taken, while the remainder will continue perfectly healthy. Of those that overcome the disease, about 50 per cent. regain their original health; the remainder are hard to fatten. I have never known a hog to die from the second attack. The disease prevails at any season of the year. Its fatality is greater among fat hogs, especially among those fed on corn.

The treatment is varied, but it is generally conceded that a small amount of alkali is the most efficacious, both as a remedy and as a preventive. A small amount of potash or concentrated lye is used by those who profess to treat it with any degree of success. We sometimes use asafetida as a preventive with success, but it is perfectly useless as a remedy. Corn-feeding will not do; it will kill in nine cases out of ten. The hogs should be penned with shelter, free from dust, and sparingly fed on any easily-digestible food. Whenever it is discovered that the animal has a desire to eat, be certain not to give it enough to satisfy it. Let it be kept hungry, not starved, but allowed about one-fourth the usual feed.

Fresh pine tar is good, both as a preventive and as a remedy, but it should be given in small quantities. Sulphur does harm, and copperas will ruin the teeth in a few days. Soda acts well. They require no external applications unless lousy. A lousy hog with the cholera would die if not cleansed. With the first treatment use alkalies perseveringly but sparingly, and the result will be 25 per cent. saved. Do not give corn unless it is ground.

Mr. P. D. BOWLES, Evergreen, Conecuh county, says:

The disease known as hog-cholera is characterized first by the animal refusing to eat, accompanied with slight dullness and sleepiness, which continues to increase from

day to day, the hog all the time refusing to eat and hiding under the straw in his bed, where he remains for hours unless driven out. The feet refuse to perform their ordinary function of locomotion, and the animal limps or hobbles about as if there was a nail in each foot, back bowed, skin red, and after three or four days looks as if blistered; in fact the hair and skin finally all peel off of those that recover, leaving the animal almost nude. They eat very little for some days, but drink water in great quantities, and have copious discharges of urine, sometimes as much as a half gallon at a time; bowels costive. I do not recollect of seeing or hearing of a case of diarrhea or laxity of the bowels. The hog continues to decline, and either dies within from five to seven days or begins to eat and gets better.

The disease has prevailed in every township in this county to a greater or less extent during the past twelve months. It commences in the early spring and continues until late in the fall. It is generally more fatal among small pigs than among older hogs. I know one farmer who has prevented the malady from getting into his herd by giving "stock powders" two or three times a week in slops or meal. Although living in sight of his neighbor whose hogs died of the disease, his escaped. I was talking with another (No. 2) a few days ago, who said he had several pigs which he had kept penned up and fed on corn and slop, and that every one had died. Some man near by had a large number running in the woods, which were frequently turned in with those confined, but not one of them took the cholera. No. 3 had several pigs, all of which showed symptoms of cholera. He gave them a teaspoonful of spirits of turpentine in bran slop, and every one recovered. No. 4 has allowed all his hogs to run at large in the swamps, feeding a little corn at times to keep them gentle. Not one has been diseased. Upon general inquiry over the country I am prepared to say that all hogs that are allowed to bed in the woods and have free and large walks will escape the disease. Let him "root or die" and you will have no more hog-cholera.

Mr. W. P. JACK, Russellville, Franklin county, says:

Candor compels me to state that as yet I think there is very little real information possessed in this county on the subject of hog-cholera, which appears to be the main disease affecting farm animals. So far as my information goes, there has been no cure discovered for the disease. It is certain, however, that hogs can be kept healthy by using preventives. In my own experience I find that when I use them I lose no hogs, but if neglected they are apt to sicken and die. The preventives which I have found most effective are such as will keep the lice off them and expel the worms from the intestines. According to my theory they are the main cause of what is known as hog-cholera. I have used tar in early spring, both internally and externally, as a preventive with unfailing success. Pine seems to be a natural medicine for hogs. In the mountains they hunt for pine roots and eat them freely. Many men who reside in the mountains have told me that they never had a case of hog-cholera, and they attribute the escape of their hogs to the fact of their eating pine roots. Poke-root is another natural medicine for hogs; they root for and eat it freely. It should be boiled with their slop. Sour slop is also a preventive. This should be mixed with charcoal. Frequent salting is indispensable. Copperas is also good as a vermifuge, and bluestone is likewise a fine remedy as a preventive.

An experienced farmer told me that last autumn, after he had lost sixty head of hogs by cholera, he had a very sick one which refused food of any kind. He finally gave it peach-tree leaves, which it ate; he then gave them to the rest of his flock, and did not have another sick hog.

Dr. FRANK PRINCE, Jonesborough, Jefferson county, says:

There is a disease prevalent here among hogs which for years has been known as cholera, but which should more properly be termed measles. The first symptom that manifests itself, on close scrutiny, is seen in the hog walking on its toes, and not upon the entire foot. But for some time previous to this the hog has been affected, and this is the result of contraction of the intercostal and abdominal muscles. There exists a latent inflammation of the parenchyma of the lungs, and cutaneous or superficial fascia, which causes the hog to contract the muscles for relief; hence he pitches on his toes. He has been having fevers several days, as is manifest by dullness and stupidity, indisposition to play, the head bowed with the nose close to the ground, and a thin, viscid mucus dropping from the mouth. Now examined, the mouth will be found inflamed, an eruption is visible in and around the throat, and the appetite is fast failing. A slight cough has set in, accompanied with occasional vomiting. The eruption soon fastens itself upon the entire alimentary tract, so that the stools soon become thin, purulent, and bloody. Great emaciation supervenes, and the hog staggers in walking. Purulent matter and blood are sometimes passed off by the animal. The hair begins to fall off as the hog becomes more and more emaciated, and a small miliary eruption is to be seen all over the skin. Without relief he will soon die. Sometimes he dies much earlier in the attack, which is caused by this purulent matter entering the blood, by which means it is conveyed to the heart and brain, and causes the animal

to turn round in a circle until it drops dead. Could this eruption be thrown out at the commencement of the attack, and the hog kept for one week in a dry house where there is no dust, he would soon recuperate. But where measles is complicated with an inflammation of the bowels or lungs, with the usual exposure to which all hogs are subject, death is almost inevitable. Hogs that are taken up and put early on treatment are apt to recover, or at least the mortality is not so great.

There are almost as many ways for the treatment of this disease as there are sections of country in which it occurs. One old and successful farmer told me that he always kept slops for his hogs made of corn or meal boiled with ashes or poke-root, and that he rarely if ever lost a hog. Another stated that he used ashes, salt, copperas, and sulphur with great success. The great secret in all this treatment is the alkali that is used. When this is administered in time it acts as an alterative, controls the secretions of the mucus coat of the intestines, stimulates the absorbents, sets up a healthy action in the lymphatics, causes the skin to assume a healthy function or action, and the disease soon disappears. So you see every one has his remedy so convenient that there is no necessity of going from home to obtain it. It consists in the proper use of good wood-ashes and salt.

Mr. P. T. Graves, Burkville, Lowndes county, says:

All kinds of farm animals, with the exception of hogs, have been healthy during the past few years. Hogs have been affected more or less fatally each year for some years past with a disease known as cholera. The disease manifests various symptoms, the most fatal of which is purging. The excrement of the hogs affected in this way is of a greenish color and starchy consistency. No settled conclusion has been reached as to the cause of this malady, nor has a remedy been found. Two points, however, seem to have been conclusively determined, viz: First, that the disease commences in damp, warm weather, during a favorable season for vegetable growth and fungoid formations. The hogs feed greedily on growing vegetation, with us mostly on cotton, and if allowed all they will eat the result is invariably disease. It is thought that atmospheric conditions have considerable influence in producing disease. Second, we find that hogs taken from a range where the disease has been developed, but showing no signs of infection themselves, if confined on dry ground and fed dry food they will escape the disease. But a clearly marked case of hog-cholera is contagious, and the disease should be so treated. Those that have heen so affected should never be used as breeders, as the taint will be imparted to the offspring. There are many remedies, so called, but caution and preventive measures will be found the most profitable.

Mr. John Herzler, Huntsville, Madison county, says:

In August last a disease made its appearance here among hogs, and by December about all that were affected had died. Up to that time mine had remained comparatively healthy, and none of them had died. I had about one hundred and forty head, and they were running in a plowed field containing about one acre to each hog. I noticed that they kept themselves well rooted into the ground and laid a good deal of the time on their bellies. Before sowing the field to wheat I removed them, and in about a month thereafter they began to die. I lost about all those that had access to the barn-yard and slept in hot places. I penned seventy-five head in a plowed lot containing about one acre of ground, and in March and April, after the lot had become hard and dry, they all died but ten. I think they were affected with typhoid fever and inflammation of the bowels. Some few would become lean and would linger for a long time; but as a general thing they died during the night, although they were apparently in a healthy condition the evening previous. Some few got well. Among those that recovered were some that I fed on warm blood from the slaughter-house. After I turned them out into the woods and swamps they entirely recovered.

ARKANSAS.

Dr. C. M. Norwood, Bluff City, Nevada county, says:

All animals, except hogs, have been remarkably healthy for several years past in this section of country. We have had a disease prevailing among swine which has proved very fatal to nineteen-twentieths of those that have been affected. The disease has been called "hog-cholera" among farmers; but from observation and some investigation I am led to conclude that cholera is a misnomer. From the most prominent symptoms, I consider it to be a lung disease altogether. The symptoms are, first, great depression, followed by languor and indisposition to move about for the first four or five days. Second, a slight, dry cough, attended with intense febrile excitement and dryness of skin. At this stage there is complete loss of appetite, and *crepitus* is audible in the thoracic region. In this form of the disease death ensues about the ninth day. *Post-mortem* investigation reveals the stomach, bowels, liver, spleen, and pancreas healthy, but the lung hepatized, the air-vesicles filled with sanguino-purulent

infiltration from the cellular tissue of the lungs, revealing the fact clearly that there has been great and destructive inflammation of the lungs. We must, therefore, conclude from the symptoms and pathological anatomy revealed by this examination that it is *pneumonitis* of an acute form. We have noticed some hogs that ate heartily and appeared perfectly healthy in the evening, and the next morning were found dead. On *post-mortem* examination this class of animals revealed congestion of the lungs, extravasation of blood into the air-vesicles to so great an extent as to lessen the caliber by infiltration, producing death by asphyxia or strangulation. I consider this the most violent and pernicious form of this lung disease.

Another class of subjects are those that recover finally. I consider this to be the acute form, terminating in a typhoid form. The duration of this type of the disease is from about ninety to one hundred and fifty days. Generally, when the disease assumes the typhoid form, there is some purging from the bowels, and this symptom, I presume, has led many to give it the name of "cholera." I consider it altogether a lung disorder, as it presents itself in this locality, and a proper study of the disease would no doubt convince many that they are laboring in error in their diagnosis of this fatal and malignant malady.

As to treatment, none has ever been adopted that has proven satisfactory. A multiplicity of remedies have been used by the farmers, but all have signally failed. The only remedy I can give that I consider at all reliable is twenty grains of calomel and one and one-half grains of tartar-emetic mixed and given every other day during the febrile excitement. After the fever has subsided give nourishment freely, such as slop from the kitchen, cooked vegetables from the garden, mush (corn), &c.

As to the prophylactic treatment, I know of none. I think the poison producing the disease floats in the atmosphere, and that it is not produced from any local cause. The best preventive that presents itself to my mind is to move the herd to some thick forest as soon as the first symptoms of the disease are observed, and not allow them to run in fields or around the farm.

Dr. J. M. JOHNSON, Locksburg, Sevier county, says:

As a physician I have been engaged in the practice of medicine in all its branches for the last twenty years. I have also had a farm, and have given a good deal of attention to stock-raising upon a small scale. As to the names given to the diseases affecting our farm animals, they are generally so far established that, whether suitable or not, it would be hard to change and eradicate them from the minds of the people. Horses, cattle, and sheep here, according to my observation, are comparatively healthy, although, like all mortal creatures, they are subject to disease and premature death. For an animal occasionally to become diseased, sicken, and die is something we naturally expect; but what alarms us most are the destructive epidemics which, for the past twenty years, are existing somewhere at all times, killing our useful and indispensable animals, as well as our much-relished and profitable fowls. Hogs and poultry here seem to suffer most from the ravages of disease.

Hog-cholera, meningitis or staggers, quinsy, and mange are by far the most common diseases among swine. The symptoms of cholera are: The hog is obviously sick, mopes about and lies down most of the time, occasionally vomits or tries to do so, eats but little or none at all. In a day or two it will perhaps have superadded a profuse diarrhea. If the disease runs a regular course, the animal will continue to vomit and purge until the alimentary canal is emptied of all its feculent or substantial contents, followed by watery or serous and sometimes bloody operations, with cramping of the muscles and particularly of the bowels. When all the above-described symptoms are seen, the complaint has reached its second stage, and is in its height or at its acme of apparent force. Here, if it does not yield to the efforts of nature with the aid of remedies, the hog will pass into the last or declining stage. If the disease yields, the animal will continue warm, and all the symptoms will begin to moderate. If not, it will go into collapse, become cold, or nearly so, continue to strain and cramp and utter low grunts, and sometimes will even shriek with pain. The duration of the disease is a good deal owing to its severity. Generally, it lasts from one to four days. All cases that result in death do not run the same course. Sometimes all of the above symptons are not present. Some epidemic symptoms are milder than others, but all seem to be malignant, for nearly all the hogs die that take it if left alone. The same epidemic is not equally severe in different cases. Sometimes the attack is so violent that the animal is in the last stage from the outset, or it may die from nervous prostration with no reaction, vomiting, or purging.

The diagnosis can easily be determined by the symptoms when they are all present, especially if the hogs are in living order, and the weather is warm; for, according to my observation, the disease prevails almost entirely during the summer months. Of the causes of the disease I can say but little, because they are not perfectly known; but we know that hog cholera is epidemic, and that it is a poison, very irritating in its action upon the stomach and bowels; that it has a preference for localities, and prevails more generally upon the borders and in low bottoms than upon lands that

have been previously overflowed. That it is also contagious we have some good reasons to believe. One thing I do positively know—that there are some powerful predisposing causes that can, I believe, be almost or entirely prevented. I will leave this point for more time and evidence, as I can only hint at the subject generally at present.

Fortunately this disease, though very fatal and destructive, often readily yields to proper treatment when administered in time. (By far the best plan is the preventive treatment, which is comparatively cheap.) The following prescription will be found valuable: One quart pure alcoholic tincture of camphor, one-fourth pound each of prepared chalk and *Hydrastis canadensis*, one pint of tincture of catechu, and one-half pint of laudanum. To administer this prescription, lay the hog on its back, place a stick transversely between the jaw-teeth, and pour down one ounce of the mixture once every two or three hours. If the first and second doses do no good, it is almost needless to persevere. The mixture should be well shaken before using. There may be other indications that could be met by proper medicines, but generally if the above fails we may as well let the hogs go.

If we carefully examine a hog that has died of cholera we will find the liver and kidneys diseased. The coatings of the stomach and bowels will also be found more or less inflamed from great irritation. We may also find patches of ulceration, with worms imbedded about the kidneys and mesenteric glands. During the prevalence of epidemics some hogs may escape the disease, while others may have it in a mild form.

Some years ago I saw a preventive advertised in a Tennessee paper, which I adopted in part, as there were some incompatibles in it, and I have found it a complete preventive not only of cholera, but of all other diseases affecting swine. It acts gently and mildly on the liver and keeps it healthy; in a word, it is tonic, diuretic, alterative, and anthelmintic in its action. It is composed of the following ingredients: To one gallon of tar add four ounces of calomel, one-half pound of copperas, and one-half pound of golden seal. Stir the ingredients well, and with a wooden paddle spread it lightly upon an ear of corn, and give one ear to each hog or shoat once every three weeks. When diseases are prevailing extensively give one prepared ear every week. When hogs are hungry they will eat every grain of the corn and will finally seem to relish it.

In answer to the question as to the average fatality from diseases among swine in Arkansas, I believe over half of the number die before they are ready for slaughtering. There are a great many things recommended as preventives and remedies which I have no confidence in whatever.

Mr. L. ORTO, Bradford, White county, says:

Hog cholera has been very destructive in some localities, yet I have been almost entirely exempt from the pest. I have kept from 100 to 800 head of hogs during the last ten years, and have had cholera among them but once. I then lost 80 per cent. of those attacked. When a hog is attacked by this disease the best remedy is to kill it and bury or burn the carcass, as this will have some tendency toward checking the spread of the disease. Moreover, if the hog should recover it will never be any account afterward. Hogs should never be allowed to sleep too long in the same beds. They should be changed about every ten days, and should be kept from dusty, dry places during the summer season. The oftener a hog shifts his range and bed the healthier will he be. They should have plenty of soap, lime, ashes, charcoal, and copperas. My hogs, which live entirely in the woods, are seldom affected with diseases of any kind. There are many wild hogs here, and I do not believe they are ever affected in any way. This is proof that the less this animal is hampered by close confinement the less is he liable to disease. The Poland-China and the Berkshire are the best breeds here.

ILLINOIS.

Mr. GEORGE L. OWEN, Bainbridge, Williamson county, says:

Swine are liable to a number of diseases, several of which frequently prove fatal, but as a general rule all are classed under the general term of "hog cholera." It would be impossible for any one not acquainted with veterinary pathology to describe the distinguishing characteristics of the several diseases to which this class of farm-stock are subject. It would necessarily require much time, diligent study, and careful research to ascertain the nature and causes of the most fatal diseases. Nor can we reasonably expect that any preventive will be discovered, or any successful treatment adopted, so long as the causes and nature of the diseases are unknown. Your correspondent remembers the time when no such diseases as now prove so destructive to swine existed, at least in this part of Illinois; a time when farmers could keep almost any number of hogs without the fear of their being attacked by any disease. But at present it seems almost impossible to keep even a very limited number without sus-

taining losses. Farmers frequently lose more or less while feeding for the butcher, and it is no uncommon occurrence for one to lose most of the hogs he has been keeping for family use, maybe only a few days before he expected to slaughter them. In fact diseases among swine are a great drawback to the success of farmers. No matter what amount of attention is paid to them there appears to be no certainty of their living till ready for slaughtering, and as a general rule farmers have settled down in the conviction that there is no cure for a sick hog. A great many remedies have been tried, but most of them have been abandoned as being useless, and in some cases positively injurious. We hope your department will be successful in obtaining from Congress an appropriation sufficient to meet the expenses necessary to a thorough investigation into the nature and causes of the diseases which are so prevalent among our domestic animals, and which so greatly diminish the aggregate amount of the wealth of the nation.

Mr. GEORGE REED, Belvidere, Boone county, says:

Domestic animals of all classes have been very free from diseases in this vicinity, except hogs. A disease appeared in my neighbor's herd of Berkshires, on the opposite side of the road. This herd was one of the best in the county. He thinks his animals contracted the disease in the car in which he shipped them to the State fair at Freeport. One pig was taken sick before he got home, and immediately after his arrival a very fine and valuable sow was also taken sick. She had a low, dull fever, was very stupid, would eat but little, and died in about two weeks after she was taken sick. She turned purple along the belly, and a bloody froth oozed from her nose. She neither coughed, vomited, nor purged. She died on the 6th of October. Very soon after, others were taken sick with the same premonitory symptoms, but also attended with coughing, vomiting, and purging. The latter symptom does not generally show itself until five or six days after the attack sets in. The excrements are of a dark color and ropy consistency, and emit a very offensive odor. The next one that died weighed about one hundred and fifty pounds, and upon a *post-mortem* examination the lungs, heart, and liver were found in a highly inflamed condition. The spleen was almost black, and the lungs full of pus or matter. This animal was constipated. The next one that died weighed over five hundred pounds. Her illness was not noticed until the day before she died. Upon examination the lungs, heart, and liver were also found highly inflamed, as were the stomach and large intestines; the lungs adhered to the ribs; the spleen was black and rotten, and the liver had a tough, leathery feel to it; the flesh along the back, which was about four inches thick, was inflamed, and there was a bunch of tuberculous-looking sores back of the right ear; the brain and the membraneous covering was considerably inflamed, and the blood was of a dark color, with a watery serum. About the middle of October they began to drop off at the rate of five or six a day, and the aid of a veterinary surgeon was frequently called in. Several *post-mortem* examinations were had of pigs that had died, and others were killed for the purpose of examination. I assisted at thirteen examinations of this character. The following general appearances were observed: The lungs were invariably highly inflamed; this inflammation generally extends to the heart, liver, pleura, spleen, stomach, and intestines, but not always to the intestines; the lungs frequently adhere to the ribs, and some portions of them are often found completely solidified, while the air-cells of other portions are filled with pus or matter; in all cases the blood was found nearly black. The duration of the disease was about two weeks, although a few lived six weeks. About three-fourths of all the pigs in the yard died. The disease seemed highly contagious, and extended to three of the neighboring farms. Two hundred and fifty head, averaging about ninety pounds, have died; not over 8 per cent. of these were grown hogs. The disease is much more fatal among young pigs, and it seems to attack the weakest ones first. At this writing the disease has almost disappeared.

Mr. J. C. THORNTON, Elliott, Ford county, says:

A disease exists among hogs here which has proved very fatal. In the fall of 1875 I lost all but sixteen out of a herd of one hundred and twenty. The symptoms of the disease vary a great deal. The first symptoms are invariably manifested in a dry cough, great thirst, and sometimes purging and vomiting. As a general rule hogs while under the influence of the disease are very stupid. The duration of the disease also varies. Some of those affected will linger along for a month or two; some will apparently get better, but after a while the flesh will begin to drop off in places, and then the animal will soon die. The larger portion of those attacked will die in a few days. I gave new milk from a fresh young cow to the first two of my hogs that were affected, and they got well; but I could find nothing that proved of any benefit to the others. I used stone-coal, copperas, sal-soda, sulphur, alum, cayenne pepper, &c., without any beneficial results.

The disease prevailed in an epidemic form, as hogs were attacked without coming in contact with infected stock. During the fall of 1875 at least one thousand head of

hogs died of the disease in this township, a tract of land only six miles wide and about nine miles in length.

In the fall of 1876 the disease prevailed again to a considerable extent, and many hogs were lost. The symptoms were about the same as those given above. During the past summer the disease again made its appearance, but this time in a milder form.

Mr. R. RICHESON, Ewing, Franklin county, says:

While there have been some diseases among cattle, horses, sheep, and poultry in the past that were the subject of some thought and investigation, their general condition and health at this time in this vicinity are such as to attract no special interest. Their health has been good, especially since the cessation of dry seasons and chinch-bugs.

With the hogs it is quite different. They are exceedingly healthy in all respects, with the exception of the prevalence among them of the disease known as cholera. From it no known condition, treatment, location, food, water, temperature, exercise, or season seems to give any guarantee of security. They take it at all ages and under all conditions, as people take measles or small-pox, and the surrounding conditions only seem to modify its effect in severity and fatality, the greatest effect generally being produced by the condition of the weather. In the mild weather of spring the percentage of fatality to those that take it is fully as low as 20 per cent.; in the fine weather of fall it is a little worse; but in the heat of summer it is often above 90 per cent., and quite as bad in the coldest of winter. Although it does not spread as rapidly during cold seasons, it makes very near a clean sweep of those that take it. The laws of its propagation are visibly these: The more the hogs are isolated the less liable are they to take the disease; the larger the herds, when it once gets among them, the greater is the percentage of cases; and in cold weather, if one of those that bed with others takes it and it is not at once separated from those not affected, the whole bed will take it and probably all die. The percentage of hogs that take the disease varies with the weather and other conditions, sometimes varying from 40 to 95 per cent. I have known a few instances of isolated herds, fenced away from any contact with other hogs, growing with perfect impunity through periods of its greatest ravages in the vicinity, which convinces me that the disease is a contagion, and is governed by the same laws of contagious diseases as those which afflict other animals. In this belief I have been strengthened by the fact that the great supply of hogs to the market come from those localities where there are no free commons for hogs, and where the breeders raise and fatten their animals; also that the still-house pens, cattle-lots, and free common country which used to raise the bulk of the hogs, are now the localities of the greatest devastation. If I am correct in the above views, the questions of diagnosis and treatment are merged into the one of isolation and prevention. I have often seen a complete diagnosis of the disease published, and any attempt on my part in this direction would necessarily be more tedious than profitable. I have noticed but few unvarying symptoms of the disease. These, somewhat modified in various cases, are: 1. A drooping of the head, with a dull appearance. 2. A wheezing cough. 3. Falling away from the food. 4. A disposition to crawl under weeds, brush, or straw. 5. Redness about the ears and under side of the body. These are the only symptoms that are at all constant in the animal while alive; but some of them are now and then wanting, while there are a great many others of a varying and often conflicting character. After death, in the great number of cases that I have opened, there is one conspicuous feature, *i. e.*, the absolute absence of blood in those that linger a few days, and the collapsed condition of the lungs. Otherwise, I never could find any evidence of either organic or functional cause of death.

The incipient stages and duration of the disease are as varied and irregular as other symptoms of the malady. I have seen hogs eat heartily at night, in apparent good health, and next morning be found dead. In most cases they will take a little food the first day, and sometimes for several days; again, they may live for weeks and finally die of the disease. The most general duration, however, seems to be from three to six days.

As remedies, I have known almost everything being tried, both in the vegetable and mineral kingdoms. I have often heard of specifics, and known parties who believed in them; but it has invariably turned out that the cholera eventually got among their hogs under unfavorable circumstances of weather or other conditions, and they died as did those not treated with these specifics. I have doctored hundreds, and am satisfied that if I ever cured one that would not have got well without treatment it was with petroleum—drenching a hog of two hundred pounds with about one-half of a teacupful at a time once a day. But my experience is that if a hog has the cholera bad and recovers or is cured, it has but very little value afterward. The only practical treatment is to change them to fresh quarters, separate the diseased hogs from the well ones, and isolate them from one another as much as possible.

In conclusion, I must express the opinion, which has grown to a conviction with me, that the only practical remedy for cholera is to isolate the herd, to prevent the moving of diseased animals through the country, and to prohibit their wandering about with

impunity, carrying and spreading disease as they go. Leaving the matter to regulate itself has caused this locality, which formerly sent great numbers of hogs to market, to be short of a supply of swine to make meat for home use.

Mr. R. K. SLOSSON, Verona, Grundy county, says:

The hog seems very much more subject to fatal diseases now than he did forty years ago. To arrive at a correct etiology of the diseases of this animal, which forty years ago were unknown, we are forced to notice the then physical condition of the animal as compared with his present, tracing the changes which have been effected by confinement, change of food, and the practical method of producing new varieties which shall take on the greatest number of pounds of muscle and fat in the shortest time. Of all the domestic animals the hog is the most easily made to undergo changes of form and temperament, and hence it is that the varieties of the hog are continually increasing. New breeds, well advertised and puffed, are multiplying, and the great and only object appears to be to find a variety that shall eclipse all others in maximum weight at the earliest possible period of their existenee. In the insane pursuit of gold stamina of constitution are lost sight of, and the hog-raiser who has three hundred head to-day in four weeks' time may be reduced to half a dozen head. He sustains a loss of $3,000 from the emasculated system of the hogs making them susceptible to disease which a healthy and strong constitution will not take on. A change of constitution was doubtless brought about in part from confinement, a condition unknown to the hog before domestication. Confinement, as all physiologists know, decreases muscular growth and strength, and the nervous energies are correspondingly weakened. On the heel of this a change of food takes place. Indian corn is fed in many parts of the country to the exclusion of those kinds of food upon which he had previously lived, for hundreds of years perhaps, and corn is almost exclusively fat producing. This combination of new circumstances and conditions necessarily produces physiological changes in the system, and these changes being, to say the least, partially abnormal, the body is prepared to take on diseases which were originally unknown to the hog. It is these changes which create a predisposition to disease which hitherto inoperative causes have failed to develop, but now being brought into action the enervated system falls an easy prey. Is it not reasonable to suppose that muscles accustomed to daily toil for sustenance, when deprived of that healthful exercise, should become weak, flabby, and deprived of much of that vitality which constitutes perfect health? Departures from the irrevocable laws of animal life in its perfection is invariably accompanied with loss of some kind, and hence violation of physiological laws are dangerous.

We need not wonder that an active nervous system, from close confinement and relief from all anxiety about satisfying hunger, should change the temperament to a lymphatic one, which is the prevailing one of fat animals as a rule. We need not wonder that changes so conspicuous should lead to disease and a shortened span of life; that stamina of constitution and longevity should be wiped out with the sponge of disease. We conclude, then, that the above causes indicate a condition of the system which predisposes it to the taking on of certain diseases so fatal to the hog. These are, in medical language, the remote causes; the immediate causes now require a brief notice. The class of diseases which, under various forms, takes off so many hogs, horses, and cattle, has proved a stubborn enemy to veterinary students; and *post-mortem* examinations have only revealed the existing pathology of diseased parts, not the immediate existing cause of the phenomena presented. This class of diseases seem to belong especially to the mucus membranes, those tissues which are exposed to the direct action of causes existing in the atmosphere or in the food. The causes of epizootic diseases, and those which produce typhoid types of disease through the medium of the bowels and stomach, are floating in the air, or exist in the food taken into the stomach. It is now admitted by some of the best authorities that epizootic diseases are caused by a vegetable growth, the minute spores of which are breathed into the lungs, as they are floating in the air we breathe, and also that some typhoid forms of fever, as hog-cholera, are of either animal or vegetable growth, and that the spores or minute eggs are introduced in the food. What is singular to the non-physiologist, these spores coming in contact with healthy mucus surfaces will not vegetate, showing that certain definite conditions are required in this membrane to produce disease at all; or, in other words, there must be a peculiar abnormal condition of this membrane before there can possibly be a development of these diseases. A further examination of the matter of the stomach and bowels by a powerful microscope is very desirable, that more positive and reliable knowledge may be gained, which may point out a treatment which, thus far, has been little less than an opprobrium to veterinary practice.

Symptons of hog-cholera are not unfrequently modified, or new symptons added. The characteristic symptons, which are never absent, are fever, refusal to eat, disposition to lie undisturbed, and a fetid discharge of dark-colored feces. We suspect the distinctive feature which shall distinguish hog-cholera from all other disease will be found in the peculiarity of the fecal discharges, and these can only be demonstrated by careful microscopic investigation.

The treatment upon which any reliance can be placed, so far as we know, has not yet been discovered. It is true quackery raises her hydra head and floods the country with sure cures, but whether from medicine taken or in spite of it, we do not know. As a rule, about the time we find out the hog is really sick, the disease is so far advanced that remedies may be considered useless. We have seen it stated that turpentine has been given, about a teaspoonful to the hog, and with success. A further trial is desirable, for it is not impossible that turpentine may kill those minute specks of life without injury to the mucus membrane. An accidental discovery of this kind would save millions of dollars annually. But there are other diseases, among which pneumonia is not uncommon and often fatal. For instance, we have known cases where the hogs piled themselves up on the wet ground under cover, so that they became steaming wet; they then rush out into the cold air to eat their corn, take cold, and die of pneumonia. Hogs are often troubled with worms, which greatly disturb digestion and make the appetite capricious, keeping them thin in flesh. Copperas in their swill, at the rate of two table-spoonfuls to the pail of swill, will clean out the worms and greatly improve the health of the hogs. Repeat this twice a week for a few weeks. A large farmer in Kendall county this fall lost 300 head of hogs, but he came to the conclusion, whether the true one or not, that the disease was not true cholera, but a form of disease which he believes was produced by a stagnant pond of water in the field. They were in the pond a good deal, and the pond was covered with a green scum. This may have been a malarial disease in some respects analogous to the genuine cholera.

Since, from the nature of the case, the disease is not noticed until it is fastened upon the system and beyond the stage in which curative measures may prove successful, it is wisdom to fall back on a surer and more feasible plan—precautionary measures of prevention. The question arises, What may be considered in some sense prophylactics in this class of diseases? The answer is, Preserve a healthy play of the organs of the body, and the causes producing these diseases cannot act on the mucus membranes, and consequently no disease will be produced. A weakened and partially diseased mucus surface seems to be a prerequisite to the sprouting of spores in the lungs or the hatching of eggs in the stomach and bowels. Right here we are met with the very pertinent question, Can we prevent the development of disease where the predisposition is always present by any treatment of the animal? Like hereditary consumption in man, so long as the health of the animal is sufficient to resist the causes acting on the predisposition, so long will the disease be absent. What, then, can be done toward saving millions of hogs annually? First. They must have a dry and comfortable place to sleep, and this apartment should be cleaned out every few days, and, if necessary, washed out also. Second. They must have clean water so arranged that they can drink whenever it suits them. Third. They should have salt at least twice each week and stone or charcoal, which is better, every week. Fourth. They should be fed upon a clean floor, and their feed should be mixed or frequently changed; cooked food, with apples or potatoes for desert, and then corn in the ear or hasty pudding. Fifth. In summer they should have all the timothy and clover they will eat. This treatment would doubtless save a host; but so long as a predisposition exists, there will be more or less disease, and so long as new varieties are being developed, there will exist an instability in breeding, which tends to weaken rather than strengthen the constitution of the hog. We doubt seriously whether hog cholera, under present modes of breeding, can be either prevented or successfully treated. Still, accident may discover a remedy which will kill the living cause of disease without injury to the animal. Of course we do not recommend going back to the "alligator pike" or the "Ohio rooter," charged with stealing potatoes out of the second row in the adjoining lot. We do believe, however, that the hog needs more exercise, a greater variety of food, and that he should not be bred in and in, as all our best breeds have been. We have too many varieties now, and the more we get and undertake to breed them pure, the weaker and more liable to disease will the hog become.

Mr. B. WHITAKER, Warsaw, Hancock county, says:

It is with much gratification that I learn that the diseases affecting farm animals is about to receive attention. The losses in this county from hog cholera alone are estimated in cash value at $30,000 per annum. In a recent report of the State Board of Agriculture the disease was said to exist in eighty-eight counties of the State, and from authentic and well-digested reports the annual loss was estimated at $7,880,060. The terrible fatality of this disease and the great losses sustained thereby is the strongest argument that could be offered in favor of a speedy investigation into its causes. Remedies without number have been prescribed, but without any appreciable effect. The disease, in its various forms, is veiled in so much mystery that a correct diagnosis is rendered very difficult. The symptoms generally, as I have observed them, are about as follows: First, the hog becomes stupid and refuses to eat, sleeps a great deal, and dies within a few days. Second, it may be constipated or exactly the reverse. Where diarrhea prevails the hog may die soon or it may linger along for several days,

all the time losing and shrinking in flesh. Sometimes animals affected in this way recover, but they remain poor, gaunt, and apparently shriveled up. Young hogs are generally affected with a hacking cough and a noticeable jerking pulsation in the flanks at every inspiration of breath. Pigs and shoats will sometimes linger for weeks with these symptoms. Still another symptom is observed in cases where the hog seeks seclusion, with every appearance of a severe cold or chill. It will crouch into the smallest possible compass, apparently for the purpose of securing warmth. Some hogs are attacked with vomiting and purging, which symptoms continue until death ensues. The disease is more fatal with fatted hogs than with any other class. Many of these drop dead without a struggle, and without any visible symptoms of disease.

Intestinal worms may possibly have some connection with the diseases which affect swine. I was informed by a gentleman who performed the operation, that in spaying some hogs last year he found the intestines of one greatly distended with worms. He opened them and took out fourteen long, large worms, and closed the opening without completing the operation of spaying. The hog lived and did well. Another case, where the intestines were opened, a large number of worms taken therefrom and the hog afterward spayed, the operation proved fatal. Proof is abundant that intestinal worms are common to most hogs, both in sickness and in health.

I neglected to state in the proper connection that all hogs affected with any of the above symptoms refuse to eat, hence the difficulty of administering medicine.

Mr. W. W. Hinman, Cambridge, Henry county, says:

Hogs have been dying at a fearful rate in this part of the country for over a year past. The disease seems quite general and widespread. However, there are a great many farmers that as yet have had no sickness among their hogs. During February and March last I lost twenty-five head. The disease seems to attack the lungs, as a harsh, rattling cough is generally the first symptom observed. This is sometimes accompanied by vomiting and purging, the latter symptom being a very dangerous one. In most of the cases that came under my observation the animals were constipated. In all cases the excrement was very dark in color. There is nothing certain about the duration of the attack. Some die in a few days, while others linger for two weeks or more. I lost about one-third of my entire stock of shoats. Hogs that are nearly matured are not so apt to take the disease.

I do not know that I can give a diagnosis of the disease, as I have never been present when a *post-mortem* examination has been made. Of one thing, however, I am quite sure—the lungs are the place where the disease originates, and they continue to be the main cause of disturbance until the hog dies. I used various remedies, my first being wood-ashes and salt—two or three parts ashes and one part salt. After that I used turpentine given on coal (anthracite). This seems to help them. I also used carbolic acid, sprinkling the places where they slept and putting a small quantity into the water they drank. After using the carbolic acid thoroughly for a short time (two or three days) my hogs began to improve rapidly; in fact I think I lost but two or three afterwards, and they were bad cases when I commenced using it.

Mr. J. A. Jordan, Orion, Henry county, says:

There is no special disease affecting farm-animals here except that affecting swine. What is known among us as cholera is at present and has for months past made fearful ravages among all classes of hogs. I am unable to furnish your department with the number of hogs that have died in my county (Rock Island) within the past four months, but after diligent inquiry I am satisfied that one thousand would be a low estimate of the loss we have sustained, and $15,000 would be a fair estimate of their value.

The cause of this disease is totally unknown, or merely conjectural. It is generally supposed, however, that it is caused by being fed too long in one place, or by eating their own filth. Feeding on plank floors and keeping them well cleaned off and sprinkled with slack lime has proved highly beneficial.

Any description I might attempt to give of the hog-cholera would be of little service to the department, as it is developed in a great many forms. I will, however, say that the hog when first attacked appears stupid and refuses to eat, is often very much relaxed, and occasionally passes what appears to be blood. They usually live from two hours to two or three days after the first symptoms are observed.

Mr. Charles F. Ingals, Sublette, Lee county, says:

Hogs are about the only animals subject to disease in our county, and so far as I have observed the ailment is of one and a similar type. It occurs at no regular intervals, and not oftener, I think, than once in ten years. I have been in the business here forty years, and until last summer my stock have kept comparatively healthy. Out of some two hundred shoats I lost about thirty, and those were the smallest and latest pigs. Grown stock seldom suffer. The animals lose appetite, become stupid, dwindle away slowly, and die, one here and one there as the case may be, in from one

to three weeks after they are manifestly attacked. Upon being started up from their nests suddenly they usually are taken with a short hacking cough, but this does not continue when they are again at rest.

I do not now remember any stock-raiser who has twice had the disease to any extent among his hogs. Sometimes out of a herd of two hundred head half of them will die inside of ninety days, and those that die first are generally the smallest. My usage is to give my animals extensive range, plenty of green feed, and to continually keep before them salt, ashes (wood or coal), stone-coal, and sulphur. They eagerly eat coal, and I provide it for them by the car-load. I have thought that high feed with Indian corn from generation to generation has worked constitutional debility in the hog. At any rate, after failing in finding any preventives, I have little faith in efforts to cure them after they once get sick. Isolation of all animals that are sick is found favorable to the well ones and to the recovery of those that are sick. Various specifics have been used and recommended, but so far as I know have effected but little good. If kept warm, dry, well fed, well ventilated, and in lots of fifty or less, disease will seldom be known.

Mr. GEORGE HUNTER, Carlinville, Macoupin county, says:

Presuming that breeders of the several classes of farm-animals and fowls will respond to your circular-letter with such information as concerns mainly the class with which severally they are most conversant, I shall confine myself to a few pertinent facts coming under my observation as a breeder of swine. I state upon careful inquiry and personal observation in my own neighborhood and adjacent localities, that about 20 per cent. of the entire hog-crop, in numbers, die annually of the various diseases incident to swine. Of this loss about 15 per cent. is probably due to hog-cholera, and the remaining 5 per cent. to other (practically) obscure ailments. In this section of Illinois, which is one of the heaviest corn and pork producing regions of the West, I should estimate the loss annually, in dollars, by the diseases among swine, as equal to about one-fourth of the entire hog product. From the mass of general statistical information to which one properly turns in this connection, it may be inferred with a reasonable certainty that in this class of animals alone the country at large sustains an annual loss of at least $15,000,000 by the ravages of disease, the State of Illinois bearing perhaps $2,500,000 of the loss as her share.

As to measures of prevention or treatment (inquired of), whatever may be known to veterinary science, or possibly professional skill, nothing, by way of general relief, has been accomplished. No precautions of a general character to prevent the spread of contagion, no concert of action for the purpose of disinfection, has ever, so far as I know, been attempted. And basing my observation upon the magnitude of the interest involved, the widespread character of the evil, and the highly contagious and fatal character of the disease prevailing, I respectfully submit that no amount of private enterprise or personal effort can avail for the protection of the public good, and that no system of prevention or disinfection can ever be adopted, of a sufficiently general or uniform character, to be effective in protecting the public interests in this matter, unless that system rests upon the authority of government, and an adequate fund, such as Congress alone can provide.

It can scarcely be of service to increase the enormous mass of confused, illogical, and contradictory reports of diseases and treatment which are found at every hand, as enough already appears in these accounts to show that nothing more is to be hoped for in that direction. Facts enough have been laid before the public, observations and conclusions enough, bearing the test of scientific experiment, have been made, upon which to predicate the belief that a competent commission, having the requisite authority and funds, could easily frame and establish a system of simple sanitary measures which, being generally applied to this class of farm-animals alone, would result in a vast saving to the country, even though no specific cure for that dreadful scourge, "hog-cholera," should be discovered. Let the appropriation be made, let the commission be authorized, and let its investigations be thorough and searching. This I take to be the general view of the subject on the part of those who have given the matter attention.

Mr. T. H. BARR, Augusta, Macon county, says:

Hogs have been destroyed every year for the last twelve years in this locality by a disease known as "hog-cholera." The disease has never, as far as I have been able to learn, prevailed in the open prairie without our being able to trace it to some marked source of contagion, such, for instance, as native swine coming in contact with hogs brought in from localities where the disease was prevailing. The disease prevails almost continuously along the timber belts on the water-courses, owing doubtless to the fact that hogs are suffered to run at large, while many careless persons throw the dead carcasses of the animals into the streams, thereby spreading the disease along the whole length of the water-course below.

Where the disease breaks out spontaneously as it were, the symptoms are a violent

cough attended with high fever. I have been told that on examination of such cases after death the lungs were found in a decayed or rotten condition, while the other vital organs presented little or no derangement. Such cases originate in close, ill-ventilated quarters, such as are found under the floors of old buildings or about or under straw-stacks. The carcasses of such, if eaten by well hogs, or even the droppings from them, will communicate the disease in a more intensified form and fatal character than that described above. With the latter cases the hogs die more suddenly than in the first instance, sometimes within twelve hours from the attack, while the former will often linger for days. In some cases the latter, in addition to the cough and high fever, will be extremely costive; in other cases the animal will be affected with an active diarrhea. Some will swell up about the ears; the skin will crack open and the blood will ooze therefrom. All or nearly all of those thus affected die. The few that do recover had better die, as they rarely become thrifty again.

We have never yet found a remedy that will effect a cure. The best-informed stock-raisers are of the opinion that relief must come, if it ever does come, through preventives rather than through remedies.

Those of us who have been most successful in keeping our hogs free from disease have done so by giving them good, comfortable, clean, well-ventilated quarters, and as a general thing those who most nearly meet these conditions have the best success.

Mr. J. S. TAIT, Decatur, Macon county, says:

I never lost any hogs until last winter, and I think that was the result of trimming in November and the early part of December. I then changed them from a warm bed to my cattle-lot. Although this was covered and protected from the storms, the ground was wet and frozen, and the hogs took cold and continued to drop off one by one until spring; but as soon as the sun came out and warmed up the earth they commenced to recover.

The only preventives I use are charcoal, wood-ashes, salt, and unslacked lime. In the summer season I put sulphur, copperas, and assafetida in the swill-barrel. I tie these drugs in a cloth and suspend it in the barrel. I give my hogs a roof to protect them from the storms of winter. If they have bedding it should be just sufficient to keep those on the outside from becoming chilled. Corn-stalks are the best bedding for swine.

My opinion is that hogs, as a general thing, are not properly cared for. Very often they become chilled through the night, or, if their beds are too warm, they take cold on leaving them early in the morning. Then follow lung affections, typhoid fever, and many other diseases to which they are subject.

Mr. JOHN L. S. DEBAULT, La Rose, Marshall county, says:

In my county diseases are prevailing among hogs to a very alarming extent. Different lots seem to be differently affected. Some have symptoms of quinsy, while others seem to be afflicted with the old cholera, a disease not very prevalent this fall. However, almost every ailment among hogs is called cholera. An entirely new phase of the disease seems to be prevailing this season among my own hogs. They had the run of a very large pasture, comprising creek-bottom and upland, with an abundance of young timber. They had pure running water, a fine blue-grass pasture, an occasional feed of corn, and in addition followed a herd of corn-fed steers. I had two hundred and fifty-three head, and I thought they were the finest lot of shoats I had ever seen—healthy in every respect apparently, and thrifty. October was very warm until toward the close of the month, when we had a sudden change to severe cold weather. My hogs were at once affected. They commenced to sneeze and cough, and the pupil of the eye turned white, causing total blindness in a few hours. Death would generally ensue within from ten to twenty-four hours. Their bowels did not seem to be affected; the disease seemed to be entirely located in the head and nasal organs until within two or three hours before death, after which the whole trouble appeared to be with the lungs. I think the symptoms were those of catarrh. I tried various remedies without any good effect. Among other things I did was bleeding, but this only seemed to hasten death. I then tried turpentine, sulphur, and copperas with like ill success. Finally I sent to Grundy county for a hog-doctor, who had great success in killing all he undertook to cure. I changed the quarters of those that remained, placing them in dry hospital buildings, in small lots together, where I could give them medicines at pleasure. This did not stay the disease, as the confinement appeared to cause it to rage with greater virulence than before. I finally lost two-thirds of my herd—one hundred and fifty-five out of two hundred and thirty-three—before the disease abated. My opinion is that the disease was caused by too high a temperature of the body when the sudden change of weather took place in October, and the consequent sudden cooling of the outside surface.

Mr. RICHARD WRAY, Richmond, McHenry county, says:

I have been breeding stock in a small way for forty years, and during that period have had diseases among my hogs three or four times, but fortunately they did not do

much damage. Four years ago my hogs showed symptoms of disease. When first discovered two of them could not walk. The place where they slept I found to be damp and wet. Several of the animals were stiff in their joints, and in addition were coughing. I bled the two that were the most seriously affected, in the mouth, and put them in a hole in the horse-manure pile. I covered them all over, with the exception of the nose, with the hottest manure in the heap and then poured two bucketfuls of cold water over them. This was in the morning, and I left them there to steam until night. I then took them out and they appeared to be well. I had to leave home that day, and was absent for several days thereafter. I ordered my men to do the same thing with other hogs that might be similarly attacked. The next day two other hogs were taken sick in the same way, but instead of putting them in a hot place in the manure they put them where the temperature was very low, and the result was that they both died. By separating them into small lots and giving them dry beds to sleep in we lost no more.

I have had sucking pigs affected with fever, hard breathing, and costiveness, for the removal of which difficulty I have used a syringe with some success. The second stage of this disease is hemorrhage of the bowels, of which the pigs die. The principal cause of the disease, I think, is the lack of dry, warm beds, and the sleeping of too many together.

Several farmers near me have sustained severe losses among their hogs this year. One of them told me that spirits of turpentine had been of more benefit to his animals than anything he had tried.

Mr. GEORGE STOCKS, Dalton City, Moultrie county, says:

Hog-cholera is the scourge of Central Illinois. I have had some experience with it; I think it was in 1867 when I lost from thirty to forty head, all I had but one. The majority of my neighbors lost in about the same proportion. The disease was admitted by all to be the true hog-cholera. The animal would first commence to cough, would get off its feed, and its feet would seem to become very tender. It would creep to its bed with nose and tail down, and generally die within from one to three days. One widow woman near by lost none, and on inquiry I found that she kept a few ounces of asafetida inclosed in a sack and suspended in the slop-barrel. I adopted the same preventive, and occasionally gave coal ashes, copperas, and sulphur, and for three years lost none. Early in 1871 I met with a report of a stock-grower's convention held, I think, in Lexington, Ky., at which one of the delegates stated that he put on the market every year from five hundred to six hundred head of hogs, averaging four hundred pounds in weight, and claimed that he could either prevent or cure the hog-cholera with the following prescription, viz: Four ounces of crystallized carbolic acid dissolved in one-half pint of rain-water. Dose, twenty-five drops to each hog, or one teaspoonful to four hogs, given in a little slop or milk.

On my place I generally have from forty to seventy hogs, large and small, and have used the above remedy for seven years with success. During that time I have lost only one, I think, and it did not have the cholera. Although this county has lost heavily, we are not alone, as I yesterday heard of one gentleman, residing near Dalton City, who had lost twenty-three of a herd of twenty-six large hogs within the past few days.

I have given the above receipt to many persons, but often on inquiry have found that they failed to use it. Since using it I have had six or seven hogs so bad that they would neither eat nor drink, and I had to pour the medicine down their throats. In every case they recovered.

Mr. J. B. TURNER, Jacksonville, Morgan county, says:

As regards hog-cholera, its symptoms are so utterly various and discordant that it is impossible to describe it by such means, or to expect that the same, or even similar external symptoms, will uniformly attend it. Hence some think that different diseases pass under the same name, and probably if we should insist on naming it from its external symptoms we should have forty different diseases instead of one, but these divers names would hinder rather than help us. Mr. Kirby, of our city, who has cut up thousands of them this year, as also in previous years, in order to steam the grease out of them, informs me that, whatever may have been their antecedent symptoms, their lungs and liver appear uniformly most deeply diseased, and they may die, as persons with diseased lungs do, either with purging or constipation of the bowels, or with neither, but more generally with purging. But, whatever the symptoms of the disease, it is difficult to believe that its general producing causes are not the same. These causes I believe to be too exclusive feeding on some one or two kinds of food and excessive breeding for mere fat, both of which produce a general weakness and hereditary degeneracy of the race. This general deterioration in stamina or vitality prepares whole droves or generations to periodically succumb to any and all unfavorable external conditions. They become in time, so to speak, "consumptive families," and mother nature steps in and in one way and another thins off most of them, because

she does not want to breed any more of the kind, and, as usual in such cases, at last throws the disease down and stops its last ravages in the last generation, or in the young pigs, while the older or tougher ones escape. In confirmation of this I observe, first, that the hog is by nature the most omnivorous feeder we have, and this law of his nature cannot, with impunity, be continuously violated; and, second, that this disease has never greatly prevailed except in the West and South, where the habit is to feed mainly on corn and grass at most, or acorns or still-slops, or even something worse. For years our large and fine droves of hogs kept in the State hospital near by, and fed on the miscellaneous offals of the tables, never had a case of cholera among them, however much it raged on the farms all around.

But this is only an antecedent, remote and general, or producing cause of the disease at best, though it is highly worthy of attention. The nearer proximate causes of each immediate outbreak are irregular and careless feeding, wretchedly poor and insufficient water, and above all lying on cold, damp ground, or in pens too warm, or where the hogs pile together in a heap, or in straw or stalks, in order to keep warm, and then, when reeking with sweat, the under or warmer ones run suddenly out into the cold air, contracting, inevitably, some form of disease of the lungs, which, repeated month after month and year after year, at last ends in epidemic cholera. When, after this long-continued violation of all the laws of nature and of health in the animals, the final catastrophe of specific cholera at last comes, it probably comes to its final work armed with some form of specific contagion as the immediate cause of the disease, as is the case in so many human diseases—much as the farmer, when he intends to kill his hogs he takes his butcher-knife along with him. The knife is the specific and immediate cause of the death of the animals, while shortness of corn to keep them longer, or the fact that they are fat enough, or the want of money, may be the more remote and general cause. This "cholera butcher-knife," or specific cause, will probably be found to be (as it is in so many of our worst human diseases, such as the most malignant forms of fevers, cramps, diphtherias, &c.) some form of fungus propagating itself by its microscopic spores, perhaps from the immediate breath of the diseased animal, to all those, and only to those, already predisposed to it, prove causes such as are above mentioned.

I am more inclined to believe in such a specific cause from an incident in my own experience. Some ten or fifteen years ago my sons wrote me that all the hogs on one of our farms were dying with the cholera, and I think nearly one hundred of their best fat hogs had already died. My hogs here had had the cholera badly, but a neighbor gave me an empirical recipe for it which some one had given him, and which wholly arrested it in my hogs. This recipe I sent immediately to my boys, directing them to get it and apply it thoroughly, and also to attend strictly to all the remote causes above intimated in their future feeding and care, and to give the preparation as a preventive whenever any cholera appeared on the farm or in the vicinity. They did so, and we have lost no more hogs from cholera from that day to this on any of our farms, though it has frequently raged all about us. After sufficient trials I published this recipe, together with the facts, in our Prairie Farmer. This was some ten or fifteen years ago. Entire strangers in various parts of the West have since written to me for that recipe, saying that they had tried it at the time and saved their hogs; were now having the cholera again, but had lost the Farmer containing the recipe. A few years after, some speculating scamps visited all the fairs in the West and sold the farmers a secret sure cure for the cholera for $5 each, with the condition that the secret was never to be divulged. They happened to offer it to a friend of mine, who knew it to be my identical published prescription. I then published it again, with the facts, and stopped them in their swindle. All the alleged effective cures I have since read or heard of are of the same general nature, and many of them contain more or less of the same specific things. They all seem to aim at two things, viz., correcting the acidity and generation of gases in the stomach and bowels by constant supplies of stone coal, charcoal, ashes, alkalies, black antimony, &c., and the extermination of the specific fungi, or cause, or its repulsion from the system. The general nature and effects of all those remedies, such as sulphur, saltpeter, coal-oil, chloral, asafetida, spirits of turpentine, &c., seem to look toward the repelling of the specific fungi or contagious cause, whatever it may be. For these and similar reasons I am inclined to believe in specific contagion, propagated from the living rather than from the dead animal, and possibly through the atmosphere. Perhaps these suggestions may awaken a curiosity to know what the quack remedy is that has served us so well. I say quack remedy, for there is no pretense of any scientific adjustability about it; nobody knows who started it or why it was started. We tried it simply because, in our then need and despair, we were willing to try anything that was offered. It served us well, though we knew not why it did, and so we commended it to others; and so far as we know it did as well for them. But in some new or different phase of the disease it may fail utterly, for aught I know, as many similar specifics do.

No hogs in cholera latitudes should ever be kept without dry sheds or pens, and plank floors or dry dirt to sleep on, and so few together that they will not pile on cold

nights, nor without plenty of good water, stone coal, and salt and ashes, mixed and perpetually before them. If stone coal cannot be had, use charcoal, or even soft brick-bats, and add sulphur to the salt and ashes. All this should be perpetually before them. Add to this as great a variety of food and as frequent changes—if it is only from corn to grass, bran, shorts, &c.—as it is practicable to make. Then whenever the cholera is around we should keep constantly before them, in a dry trough, as a preventive but not as a cure, the following mixture:

One peck of wood ashes, four pounds of salt, and one pound each of black antimony, copperas, and sulphur, and one-fourth pound of saltpeter. Pound fine and mix thoroughly, and set in a dry trough where the hogs can have free access to it. This is as the recipe was given me. If the cholera should again attack my hogs, I would now add a pint of coal-oil and a half pint of chloral in solution.

Mr. A. COFFMAN, Reynolds, Rock Island county, says:

At present the only prevalent disease among farm animals here is cholera among hogs, and of this there are so many different forms that it is difficult to give a diagnosis of it. It not only occurs in widely-different forms, but also under circumstances and conditions as varied and as widely different. Hence no theory has yet been advanced here but that some well-known facts occur which knock the theory "higher than a kite."

The form of the disease which prevails here to the greatest extent, and which causes the greatest loss to hog-raisers, is what is termed pig or shoat cholera. I should say that it resembles a low form of typhoid pneumonia, generally attended with a violent cough, sometimes with vomiting and purging, frequently with sore head and eyes, the eyes sometimes bursting entirely out of the sockets. They sometimes live for weeks, all the time wasting away, and occasionally die within a few hours. This form seldom attacks hogs a year or more old. The more violent forms vary so much that I will not attempt a description. As to the remedies, they are as varied as the notions of the owners can make them. Everything that is heard of or can be thought of as likely to be of benefit is tried, but as often fails. My own experience is (and I have had considerable of it) that medicine is of little use. I had it among my shoats last winter, had previously used nothing to prevent it except a little concentrated lye occasionally (if that be a preventive), and used nothing while it lasted in the way of medicine. I changed their rests every other day, and had them driven considerably every day. Under this treatment I lost but few, and escaped better than my neighbors. Still I do not advance this as a sure means of cure. I have more faith in it, however, than in all the drugs of the apothecary combined. Others have tried the same treatment to some advantage. The disease is very destructive here again this winter. I sincerely hope, with the combined efforts of yourself and the stock-raisers of the country, that some preventive may be found for this scourge.

Mr. GEORGE P. WEBER, proprietor of Meader farm, Pawnee, Sangamon county, says:

So much has been written and said on the subject of hog-cholera that its consideration has become almost disgusting. Nevertheless, in a work of such great importance, I am always ready to enlist. Swine, like all other classes of animals, are subject to numerous diseases; but since the first cases of what I regard strictly as hog-cholera were known in our county, all the swine ailments are called cholera. If an animal becomes affected in any way, the trouble being invisible, it is at once pronounced cholera. Hence the great trouble so often encountered—incorrect treatment and ultimate failure. The disease was first introduced into this county about twenty years ago by large droves of half-starved Missouri hogs, bought there at a very low price, owing to scarcity of corn, and brought here to fatten when crops were fine. These animals were put upon a full feed of dry corn, and in a few days many of them were taken with violent fits of retching. In a few hours the bowels would begin to operate freely. Evident signs of griping in the bowels accompanied these discharges, which constantly grew more frequent and severe until death relieved the sufferer. Sometimes within a single hour from the first symptom the animal would die, while others would last twenty-four hours, or even longer. Very few of these animals, thus afflicted, recovered. No remedies that I have heard of were used, as it was thought to be caused by the high feed closely following the extreme starvation to which they had been subjected. In a short time, however, the native hogs began dying in a similar manner, which caused no little alarm. Since that time our county has not been free from this plague. Then began the discussion as to contagion, epidemic, &c., with which all are acquainted who have paid any attention to the disease. While these points have never been decided, I regard them as matters of great importance.

The symptoms of hog-cholera are about as follows: Disposition to remain quiet; when driven up to feed will smell of the food but refuse to eat; stand drawn up with feet under the body, back arched, head and ears drooping, eyes look weary and frequently inflamed; violent retching and vomiting; griping and evident pains and cramps

in bowels; severe scouring, and discharges not always of same character. Death usually ensues from within one to thirty-six hours. If the latter period is passed recovery is not unfrequent. Animals once affected are not so liable to attack in the future.

It would require hundreds of pages of closely-written matter to give in detail the varied treatment and remedies used for this malady. Almost all the minerals and vegetables in their different forms are prepared for medicines; stone and charcoal, lime and ashes, the different kinds of oils and salts, sulphur and soda and the various acids, mixed and compounded, mercury and arsenic; indeed the entire list is given for aught I know. I have known of seeming wonderful cures and strange failures under the same treatment and remedies. My opinion, founded upon practical tests and observations, is that the disease is epidemic and contagious. Animals should have the largest possible range; they should never be housed except in bad weather; their feeding-place should be changed as often as once in two or three weeks; their beds should be carefully attended to, and all the trash, old beds, and collections about pens and sheds should be burned as often as once a week, and the ashes left for the pigs to eat. Pigs should have access to pastures as much of the year as possible; they should be fed all the slops from the kitchen and the dairy, or as much of it as they will drink in the dry weather of late summer and in midwinter; feed and water regularly, and never give medicine unless the bowels become constipated; then air-slaked lime, wood ashes, and a little salt is the best remedy. The condition of the bowels may be readily known by watching the droppings. I am fully convinced that if the bowels are kept in a healthy condition there will be no such thing as hog cholera, so called, or in fact many other diseases. This should be done by cleanliness and careful feeding, watering, &c., and not by dosing with poisonous medicines.

Of course my *post-mortem* examinations have not been strictly scientific, as I am not a veterinary surgeon. The results invariably satisfied me, however, that the whole stomach and bowels were deranged, usually inflamed, as if greatly excited. I have found nothing that would justify a specified location, or a reasonable cause for the disease. I have examined many, as in former years I lost them by hundreds. After all my reading, observation, and actual experience, I pronounced the whole thing a mystery that can only be solved by accident, time, or science.

Mr. DONALD MURCHISON, Toulon, Stark county, says:

For several years past the hog-cholera has annually been destroying immense numbers of hogs throughont various sections of this country. The probability is that $250,000 would not cover the losses in this county alone since the disease first made its appearance. I am a farmer, and have been extensively engaged in hog-raising, and therefore have given the disease a great deal of careful thought and study, and I believe I have now found a sure remedy, if given in the first stages of the disease. The recipe is as follows:

Make a strong tea of smart-weed. After the weeds are separated from the solution, add one-eighth of a pound of arsenic and one-fourth of a pound of concentrated lye, and from one-fourth to one-half spoonful of flaxseed to the hog (according to the size of the animal). It is best to have the solution boiled over again after the flaxseed is added, or else have the flaxseed cooked in a smaller vessel and thoroughly mixed with the tea after the weeds are separated from it, then mix a sufficient quantity of oats in the tea to soak it all up, and feed to the infected hogs night and morning as much of it as they will eat. Give them no other food for a week or ten days, or until they begin to show unmistakable signs of returning health, when this feed may be gradually lessened and corn given in its place, gradually at first, and increased as the other is diminished.

The flaxseed is not necessary unless the bowels are constipated, which is generally the case in advanced stages of the disease. Some farmers use salts when the bowels become constipated; but it is about the worst thing that can be given, as it is a blood-cooler and a blood-weakener. Although it may give temporary relief it prostrates the system, and in a few days the hog will be in a much worse condition than it was at first. The flaxseed is a good laxative, and at the same time is very nourishing and strengthening to the system. The lye seems to be a good tonic as well as a good remedy for cough in hogs. The arsenic also acts as a tonic, besides it kills the worms with which all hogs (with very few exceptions) are troubled. The smart-weed is probably about the best remedy for inflammation that we have; it is warming and strengthening to the system, and gives tone to and equalizes the circulation of the blood, just what seems to be needed, as the disease is a congestion of the lungs.

Mr. JOHN C. ANDREAS, Manchester, Scott county, says:

In this vicinity the losses have been very great from diseases among hogs, that of cholera being the most prevalent. The loss of pigs recently, from one to two months old, within a circuit of two miles, has been over four hundred head. In a herd of one hundred and fifty head only two were left; in another of ninety head but eight were left. The first symptoms were extreme chilliness, even when the thermometer ranged

from 90° to 95° Fahrenheit. This was shown by their crowding in beds at mid-day, and a general discoloration of the skin, that of black hogs assuming a gray or purple hue, and the white animals a pinkish tinge; this was followed by high fever and a general breaking down of all the animal tissues, and fatal results within from three to five days. With older hogs the preliminary symptoms are the same, but the fatality is not so great. Recovery is generally followed by loss of hair and sometimes the sloughing off of large pieces of flesh. The animal is almost worthless for feeding purposes for at least one year.

As to remedies there have been none found that can be relied on with any certainty. Different compounds of antimony, arsenic, poke root, and iron (sulphate of iron) are used in some cases with apparent benefit. Dissection shows a general inflammatory condition, centering sometimes in the stomach, but more generally on the lungs. The general breaking up of all the animal tissues is shown by rapid decomposition as soon as death ensues. The usual bird scavengers seldom feast on the carcass of a hog that has died of cholera.

There are several other diseases which hogs are subject to, among which is pneumonia. The symptoms are high fever and general debility, and ultimately extreme emaciation, with small percentage of death. Long continued and the best of feeding will rarely overcome the extreme leanness of the animal. Dissection generally shows atrophy of part of the lungs, and general adhesions. I think a thorough investigation of this subject by competent persons would result in great good to the entire country.

Mr. J. ZIMMERMAN, Mount Carmel, Wabash county, says:

No diseases among farm animals have recently come under my observation, except diseases among swine. With the various forms of so-called hog-cholera I have had considerable experience in my own stock, and observation among that of my neighbors. The report of Dr. Detmers to the Missouri State Board of Agriculture, a year or two ago, contains, in the main, a better description of the disease than I could give, as well as the best remedial and preventive prescriptions I have yet tried. His statement, however, that hogs kept in small numbers, as by people in towns, are comparatively free from disease, is not at all borne out by the facts in this vicinity.

The greatest fatality is among pigs; but I am well convinced this is to a very considerable extent from mange, although denominated "cholera," with all other diseases to which the hog is subject. While induced in many instances by perfectly obvious causes, I think the mange in many cases is inherited, or is the result of injudicious breeding. For instance, I have one sow, now suckling her third litter, whose pigs in each case have been mangy, although treated as other pigs that remained free from mange. She has in each case been bred to her own sire; none of my other sows have been bred to a related male. It sometimes happens with me that a sow couples with a young, immature male; the progeny in nearly every such case are diseased.

The nesting of swine under barn-floors and the like, *i. e.*, under any low, tight covering, where there is not free circulation of air about the animals, is, in my experience, a certain inducing cause of cholera.

I have had better success from the use of Dr. Detmer's remedies, namely, tartar-emetic and calomel (particularly tartar-emetic), and seclusion of the animal, than from any other. I have administered it to quite a number, and have called the attention of my neighbors to it, and know of no instance in which it has been administered that it has not been attended with beneficial results. I can hardly think of anything that has not been recommended as a cure for cholera. I have tried dozens of so-called remedies, sometimes with apparent success, but ninety-nine out of one hundred of these, I am positive, are called remedies on no sufficient basis of extended experiment. It may be so also with the above. So far my experience and observation are largely favorable to its efficacy.

I feed in a large wood lot, where there is plenty of water and shelter from cold winds. I throw corn on the ground by wagon-loads for the animals to run to when they wish, but never two loads consecutively at the same place. I break up the nests occasionally and compel a change of sleeping quarters. I feed, at least once a week, a mixture of salt and wood-ashes. I breed only from mature animals, preferring Berkshires for mothers and Polands for sires, but lay particular stress on maturity of breeding stock. Whenever I find an animal refusing its food, or wheezing painfully, or with an appearance of thumping in its sides when it breathes, or nestling down and shivering as if it had a chill, I remove it from the lot as quickly as possible and feed it from two to four grains of tartar-emetic in a small quantity of potato cooked with a little grease to tempt an appetite. Whatever, if any, of these measures may be the cause, my swine have been measurably free from cholera during the past four years. Still, I recognize the danger that it may break out among them in a week, and also the paradox that if it were not for the losses by cholera there would be no profit in hogs.

I cannot give a reasonable guess at the average duration of attacks, so wide is the variance. I think at least sixty per cent. of the cases prove fatal.

Mr. Ezekiel Hemsinger, Burnt Prairie, White county, says:

All the material drawbacks we have here in stock-raising is that among swine, known as "hog-cholera," and from this cause our farmers have, to say the least, been kept down, and some of them have even lost their homes. We have suffered from it now for seventeen or eighteen years, it having reached us in less than twelve months after it first started in Ohio. In the first place, we are convinced that it is a contagious disease, as hogs very rarely take it in any other way than from contact with diseased animals. I live in a hog-raising district, and for twelve years past this has been the universal belief of our farmers. In all this time, with the closest observation, we have not known certainly of a case where hogs were kept in an inside inclosure where others could not reach them.

It is also a well-established fact that hogs have the disease but once. Though some of the herd may sometimes show signs of the disease, they never take it again under any circumstances. A sow may pass through cholera when a pig. If kept for a farrowing sow she will continue to bear her pigs in the midst of a dying herd until she dies of old age, and never again be affected by the disease. What is very strange and unaccountable, is the fact that her pigs, as long as they draw nourishment from the mother, will not take the cholera, but as soon as they are weaned they take it as others do.

The disease usually sweeps over our country once each year. Sometimes two years may intervene, but such a rest we have never had more than once or twice. It generally reappears about eight or ten months from the time of its previous appearance, just as measles and whooping-cough in the human family periodically reappear. We hear of the disease as existing at some distant point, and watch its progress. It gradually approaches until it reaches our next neighbor. If we can now succeed in keeping our hogs and pigs in an inside inclosure, at some distance from the infected ones, they will remain safe; but if they are allowed to smell of a sick hog through the fence they invariably take the disease, which makes its appearance in eight or nine days after being exposed to it.

The first symptom of the disease is a short, quick cough when disturbed, and an inclination to lie in bed. Some will be severely purged and others will vomit, while some will do both. These symptoms are followed by high fever, unusual thirst, and a high, purplish discoloration of the ears, belly, and flank. The duration of the attack greatly varies. Some die within ten minutes after the first decided symptoms manifest themselves, while others may linger a month and then die. The fatality of the disease also varies. Some herds may escape with a loss of 25 per cent., while others may be decimated to the extent of 90 per cent. It is not uncommon to hear of the loss of all in small, well-kept herds. The average loss is about 50 per cent. of all hogs attacked.

As to cures, we have found none. The most successful treatment we have ever found is to keep them away from water and sheltered from snow and rain. It matters not how hot the weather may be, they should have no water either to drink or wallow in. If they have grass or clover to feed on, give them nothing else. It is better for them to have nothing at all for the first week than to feed them on corn. They should not be crowded, and if daily changed from field to field, so much the better.

The majority of writers on hog-cholera seem to know but little about the disease which bears with such crushing weight on this and similarly situated districts. It is claimed by almost all of them that it is the neglect of proper sanitary conditions; but when the disease prevails, it is a well-known fact that among the best-fed and best-grown hogs the fatality is three or four fold that which attends hard-favored, poor shrimps that are but half fed and never properly cared for. We all agree that unhealthy food and foul bedding engenders disease among swine, but that has no relation to our Western hog-cholera.

In all older-settled parts of our country, hogs are restrained from running at large. This is the practice in the prairie counties of Central Illinois, where the disease is not known; but even in this section of the State there are some farmers who shut their hogs up in the barn-lot, where they are compelled to bed in the manure heap, and where they soon sicken and die of filth. Those who raise hogs successfully keep them on clover in summer; and if they have the range of the whole field for choice of bedding and of cover, they will bed in a clean place. We think we have learned by experience that there is no more healthy diet than clover for hogs, yet it is not uncommon for 75 per cent. of those so kept to die in the clover-field.

Some persons urge as an argument against the theory of contagion that the disease must have a start somewhere. We know it has a start; but where and for what purpose, we are ignorant. Isolation sometimes prevents its appearance, but not always. I have practiced this plan, and sometimes have succeeded in preventing the appearance of the disease; but at other times I have failed, and have lost hogs to the amount of $1,000 at one visitation.

Since cholera has proved so fatal among hogs, every sick or dead hog is charged to the account of this disease. Even scientific investigators have greatly erred in mistaking manure-befouled sick hogs for cholera cases.

Mr. W. O. MILLARD, Caleta, Whitesides county, says:

About one year ago the secretary of the State Board of Agriculture of this State sent me a blank to fill out in regard to the so-called hog-cholera, which was then, as now, very destructive to all classes of swine. I made out a report, and it was published in connection with a number of others from different parts of the State. When I made that report I had never been visited with the disease, and consequently was unable to give as accurate a diagnosis as I may be able to give you. The disease first made its appearance in this locality in August, 1876. But little attention was paid to it at first, perhaps because we thought it would not spread. But we were soon convinced that nothing had ever passed through the country that was so serious as this. It made its appearance in my herd about the 1st of June last, eventually almost annihilating them. When it first appeared I had two hundred and seven very fine animals of the best English Berkshire breed. Thirty days after I had but seventeen left, my loss being one hundred and ninety. While perhaps I may be considered one of our largest swine-growers, yet my loss was no greater in proportion than it was in the smaller herds.

The farmers all over this Western country are to-day being visited with the worst scourge that has ever made its appearance. In this section they are losing from twenty-five to one hundred and fifty head of swine each. As to the nature of the disease, I think it a typhoid fever, and it is so called by almost every one who has made an investigation. The first we discover wrong with the hog is its refusal to eat; and it acts, as we term it, dumpish. It either has a diarrhea or is costive. Its excrements are very offensive. Very many are taken with vomiting, while some are affected with bleeding at the nose. They seem to be thirsty and have a desire to lie in water a large portion of the time. Their eyes are red, and white matter stands in the corners of them, while many of them have a white mattery discharge from the nose. They usually live some two or three weeks after the first symptons are observable. I have seen many of them where the fever had either settled in the head, eyes, nose, or legs, and in such cases some would become blind and others deaf. We have every reason to regard the disease as contagious, and I believe a prevention better than a cure. A few hogs recover from the disease, but a large majority die. We have done everything we could to effect a cure, but so far everything we have tried has proved a failure. I hardly think it necessary to say what we have given, yet it will do no harm. We have given arsenic, nux-vomica, calomel, salts, soda, concentrated lye, and Dr. Herrick's German Hog-Cure. Bleeding has also been tried.

When my hogs were taken they were on grass, on a lot of seventy acres, well watered with pure spring water, and had no grain. Others that were sick had grain and grass, with good spring water. Still others had grain and slops from the house and no grass or water. But all were sick. My land is rolling prairie, with no standing water or low places on the farm. The farmers generally are well off and take good care of their stock, and the majority have them sheltered in bad weather.

INDIANA.

Mr. JOHN K. BEVIS, Taylorville, Bartholomew county, says:

I will give you my own experience with the hog-cholera, as it is called. It first made its appearance on my farm in September, 1857, when I lost sixty head. I examined quite a number, and found them all spotted on the belly, and the throat full of clotted blood. It appeared again on my farm in June, 1875, when I lost ninety head. The disease worked different from its course in 1857. Some would lose their appetite and dwindle away to mere skeletons before death ensued, while others would die in a few hours; some would squeal as if in great pain, and would soon die; others, again, would take spasms, which would last for some days, and then die. I used copperas, sulphur, madder, turpentine, antimony, coal-oil, in fact all the remedies that I could hear of, but without effect; at least, all that I doctored died.

Recently, I have come to the conclusion that the rooter on the nose was put there for a purpose, and have not rung or cut the nose of any swine since. I have no reason to complain, as my hogs have since done well.

Mr. G. W. BALDOCK, Charlestown, Clarke county, says:

The disease known here as hog-cholera seems to prevail all over the hog-growing country. It prevails as an epidemic in this neighborhood and county. Mr. David Lutz recently lost one hundred and twenty-three head; Mr. Isaac Koons, two hundred head; Mr. Floyd Ogden, two hundred head; Mr. Samuel Lewman, forty head; Mr. G. B. Lutz, fifty head; Mr. John King, fifty head; Mr. David King, thirty-five head; the writer, fifty head; and so on throughout the entire neighborhood. All diseases affecting swine are erroneously classed under one head—that of cholera. My hogs were afflicted with what I considered a lung disease, the symptoms of which were about as follows: The

animal became very stupid, and lost its desire for food. It would mince slightly of its food, but would swallow but very little. Some of them would cough a great deal and others but little, while still a few others would not cough at all. Although the coughing showed the presence of disease, I did not consider it one of the leading symptoms. After the disease becomes fully developed they become constipated, and the feces hard and very offensive. They nest around and seem to want to sleep all the time; eat nothing and soon die. There is no known specific remedy for this disease, be it what it may. As a remedy I tried sulphur and copperas, wood-ashes, and soft soap. These things seemed to give the well hogs a fine appetite. I gave one shoat a half pint of castor oil, which purged it freely and it recovered. As soon as I commenced feeding the above ingredients I had no more sick hogs. Perhaps some of them may prove a preventive, but I am sure neither of them can be regarded as a remedy.

Mr. JAMES FERGUSON, Ashborough, Clay county, says:

For fifteen years, at intervals, what is known as hog-cholera has been very destructive among this class of farm animals here. Personally I have had but little experience with it. In some the symptoms are refusal of food, stupor, apparently nearly deaf and blind, constipation, and death within from one to five days. Others have vomiting and lax evacuations, of which seven-tenths die soon.

Of the cause of the disease I know nothing certain, nor have I heard a rational theory from our farmers. Various drugs are administered as long as the hog survives the disease and the doctoring. I know of no reliable remedy.

Apparently it is safe to assume that worms, and, possibly, other parasites on the digestive organs are the cause of most hog diseases. Hogs that have frequent doses of sulphur, copperas, turpentine, and arsenic, with free access to wood-ashes and charcoal, are usually healthy, and almost exempt from cholera.

Mr. SAMUEL WARMOTH, Princeton, Gibson county, says:

The only animals affected with diseases in this county this year, or for several years past, are the hogs. The disease is known as cholera, and has this year carried off at least one-half the hogs in the county. Young pigs are generally the first to be attacked, and very often they all die. Then it attacks the older hogs, and, as a rule, half of them die—sometimes more and sometimes less.

The disease does not act the same in every case. Some of them are severely purged and lose their appetites and refuse to eat. Some die suddenly, while others will live for weeks moping about without eating anything. Some of them will lose a portion of their flesh, which falls off the bones while they are yet alive.

Farmers have different ways of treating the disease, but I believe there is no cure after the malady has passed a certain stage. I think it is brought on by worms, and therefore, if the worms could be kept out of the hogs they would not be liable to the disease. Salt and hickory ashes, with sulphur and copperas, will be found good preventives. Any one who will find a sure cure or preventive will deserve the thanks of the American people.

Mr. H. SHUGART, Marion, Grant county, says:

There is a very destructive disease among hogs here, called cholera, but in my opinion it is lung-fever. No remedy has been discovered that I am aware of. It is said that hogs do best, and are less liable to be attacked by the disease, that have clear, running water to drink, and are kept from a mud-wallow. This is a mistake, as more hogs die from the disease that are kept along water-courses than among those that are kept at a distance from creeks.

Mr. JOHN KENDALL, Amo, Hendricks county, says:

The only disease prevailing here among any class of farm-animals is that affecting swine. A diagnosis of the disease as a rule, seems to be about as follows: First, the existence of a dry cough for weeks before any dangerous symptoms are manifested; second, refusal to eat, and a disposition of the animal to lie down with its feet under its body; third, excessive purging in many cases, the excrements frequently being black; fourth, constipation. In cases where the urine is very yellow, or where bleeding at the nose occurs, death soon follows. Many will linger a long time after they have lost all disposition to eat; others will die within a very few days. The mortality is greatest among pigs. Where older hogs are attacked from 10 to 25 per cent. recover.

Every hog that dies in this section of country is said to have died of cholera. On examination dead ones were found to contain worms in the intestines. No satisfactory remedy has been found, notwithstanding the many "patents" and "sure cures."

The disease prevails more extensively during July, August, and September, and diminishes as frost and cold weather approach. A lot of my pigs were affected with a cough, as before stated, but about the first of September I had a valuable horse die. I cut the carcass open, salted, and allowed the pigs to devour it. Soon after they commenced feeding on it the cough disappeared, and the pigs have since been apparently healthy. Whether this was due to the fresh meat and change of diet, I cannot say.

Mr. W. W. Barnes, Howard, Howard county, says:

If there is any disease prevailing among farm animals in this county, except among hogs, it has not come to my knowledge. The so-called hog-cholera has, for the last year, prevailed to an alarming extent. In some cases the losses have been so great where large herds were held as to cause financial ruin. At this time a general feeling prevails against risking capital in this important staple.

The term cholera is generally used to designate the disease, but I doubt if a case of genuine cholera has occurred. In some localities a disease known as quinsy has prevailed—swelling of throat and jaws, attended with high inflammation. No remedy is known. In some cases the knife was used in laying open the parts affected; but the recoveries were not as high as 10 per cent.

Pneumonia, or congestion of the lungs, is, I think, the real disease. After the hogs lose their appetites and refuse to eat they live from twelve to forty-eight hours. Death, when it comes, is instantaneous. The animals fall dead in the paths in which they travel, or die in the beds in which they sleep. Where they fall in snow there is not a sign of a struggle. They are always found on their bellies, as though their walk had been instantaneously arrested. All remedies seem worthless.

Mr. J. R. Holston, Anderson, Madison county, says:

During the past eighteen months we have had a fearful epidemic among our hogs, called cholera. It has been very fatal, and last year carried off at least four-fifths of all the hogs of the county. Some think the losses were even greater than this, but to be on the safe side I put the figures at four-fifths. For ten years past the farmers of this county have been raising for market from 25,000 to 30,000 head of hogs, and during the last eighteen months they have lost by this disease in this class of animals alone, in actual cash value, from $300,000 to $400,000. These figures are large, but they are below the aggregate estimate of some of our stock-raisers. In the years 1875 and 1876 we had partial failures of the wheat crop; so during the two years, with these various causes, we have had a signal financial failure, and it will take at least four or five years, with such crops as we have this season, to catch up again.

The symptoms of this so-called hog-cholera are varied and complex, so much so, indeed, as to render it very difficult to arrive at any definite conclusion. The first symptom among young hogs or shoats is a cough, accompanied by a kind of heaving or thumping in their flanks. This continues for a few hours or a day or two, when the animal dies. Some mope around, lie in the shade, and refuse to eat. Those affected in this way live anywhere from two hours up to three or four days. Some bleed at the nose, some are constipated, while others are laxative. The last-named symptom is rare, and hogs thus affected generally get well.

There are numbers of so-called remedies and preventives, but all have proved abortive. Soft-soap, calomel, black antimony, coal-oil, dog-fennel tea, sulphur, sulphate of iron, &c., have all been used, but without effect. No specific remedy or preventive will ever be found until the origin or cause of this most fatal epidemic is discovered. The farmers of Ohio, Kentucky, Illinois, Missouri, Iowa, Minnesota, and Michigan are suffering to as great an extent from the ravages of this disease as we are here in Indiana.

Dr. John Kennedy, Paragon, Morgan county, says:

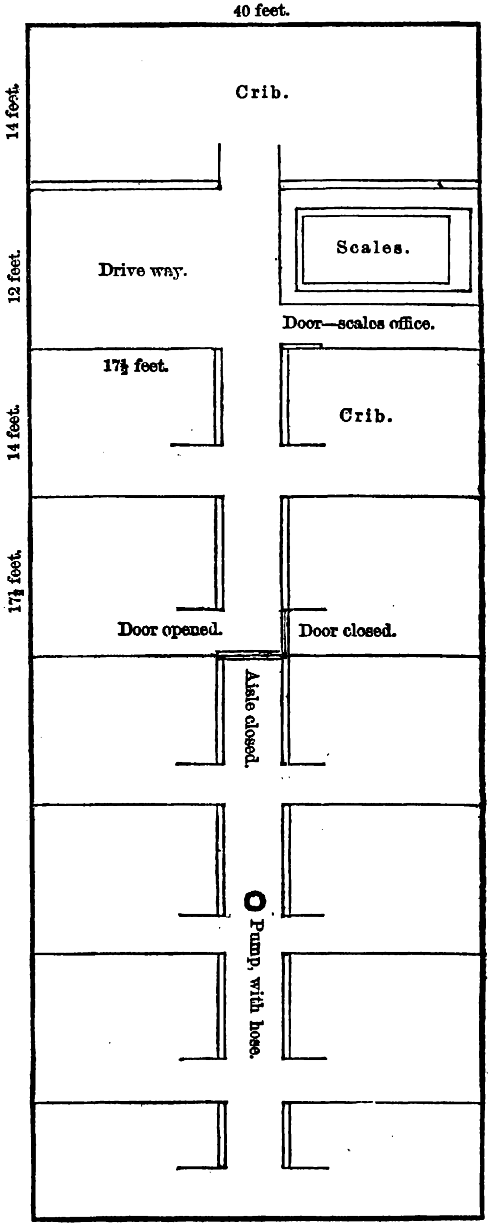
Hogs being our staple production, I shall treat of the various diseases affecting this animal, all of which are called cholera. In my opinion there are three distinct diseases, viz., lung fever (pneumonia), erysipelas, which may affect any one organ or the entire organization of the animal, and enteritis or enteric fever, a disease similar to hospital or camp or typhus fever in the human system.

The former is mainly brought on by exposure to changes of weather. The two latter are epizootic and contagious, and so closely resemble each other that I shall not attempt a distinction, as they are quite generally considered the same disease. I shall simply give distinctive symptoms sufficient to enable the ordinary farmer to know what ails his hogs.

In the colder seasons of the year, when the hogs are inclined to pile up to sleep (not being protected, as is nearly always the case in our vicinity), it is noticed that some of them do not readily come up for their morning feed, and when they are driven up they seem stupid and not inclined to eat. They may have a cough, or this symptom may not show itself for a few days further along. They are thirsty from the beginning, and the cough, which appears sooner or later, may be accompanied with bleeding at the nose and mouth, which is an evidence that the lungs are seriously affected. When this latter symptom appears it may be taken as an evidence that the animal will soon be ready for the dead-hog man. The symptoms invariably indicate lung fever. The best treatment is to at once separate the well from the sick ones, and if possible provide shelter and protection for all. If you have too many in the herd take out those that are positively healthy and put them on the market, and thereby reduce the number until you can afford shelter and protection for the remainder. A cheap

shelter and protection may be constructed by boarding solid your fence so as to shield them from the chilling effects of the northwest winds. Make a cover slanting from the top inward, and throw in stalks and husks for bedding. Further on I shall give a diagram for a barn, such as every hog raiser should have.

The next thing in the general treatment of the disease is to cease feeding everything except slop made from corn meal, with sufficient salt added to make it palatable. They should not have water oftener than three times a day. I would give from one to two pints of water from pine tar, adding five to ten grains of nitrate of potash to the pint. During the active stages of the disease and in convalescence, which will take place within from five to seven days, I would use chlorate instead of nitrate of potash. With this simple treatment more hogs will be cured than in any other way that I have known tried. If thought proper, however, a small amount of copperas may be given during convalescence, say from two to five grains to the hog three times daily in their swill or slop. As a preventive for those not affected, nothing is better than the tar-water mixed with chlorate of potash. As a disinfectant copperas water, or charcoal and wood ashes, may be used. Carbolic acid, if not considered too costly, may also be used in the proportion of one-half ounce to a quart of water. With this the beds should be sprinkled two or three times a week, using a common sprinkler or a wisp of straw.



In cases of erysipelas the hog will appear indisposed and rather mopy. At first its bowels are somewhat constipated and its feces dry and hard. Within a few days diarrhea, though not always a symptom, may be noticed; red or bluish-red spots will appear on the skin; swelling will set in, and, if the hog does not soon die, the hair will begin to fall off, and the skin, in some cases, will become surfeited and even crack open. The animal will thus linger along for thirty or forty days, and sometimes recover after it has been given over to die. This disease is liable to affect the vital organs, and when it does it runs a rapid course, proving fatal in a few days or resulting favorably in a comparatively short time. The distinguishing symptoms in this and enteric fever or inflammation of the bowels are, instead of the red spots on the skin, an eruption of red specks appear, and vomiting and diarrhea are generally present within a very few days after the attack. If not properly treated it is equally fatal with the others. As in other cases, I would advise separation of the sick from the well ones, and, in cold weather, shelter and protection, also observing like rules as to feed and water, using tar-water with carbolic acid. One

ounce of the latter to a barrel of water, and one gallon of the water to each hog per day in addition to three quarts of corn-meal thin gruel to each hog, will be found the best treatment. For those that have diarrhea, one-half teaspoonful of muriate tincture of iron may be given three times a day. A small amount of carbolic acid for the well ones may also be given. I cannot give the proportion of hogs cured by the above course of treatment, but so far as tried it has proved very effectual. To be healthy, hogs should have a fair degree of cleanliness, and where they do not have access to running water, the pools where they wallow should be disinfected once a week by the application of either lime, wood-ashes, or copperas.

Herewith I give a diagram of a barn owned by Mr. Jesse Lockhart, of Niantic, Ill., which he erected for the protection of his hogs. Two years ago this gentleman informed me that he had been using this barn for three years, and that during that time, notwithstanding he had handled several thousand hogs yearly, he had not lost one from the so-called hog-cholera.

The foregoing design comprises two cribs with a drive-way and scales between, making a main building forty feet square and fourteen feet high, with gables at each end of the drive-way. The pens attached and contiguous thereto are covered at right angles with the cribs; these pens—six side by side, or twelve in all—extend the building one hundred and five feet, which, added to the other apartments, makes the entire building cover a space of 145x40 feet. The pens, which are about six feet in height, have windows to each, with shutters, and may be closed tight or ventilated at will. The inner walls of the pens are four feet high, and the aisle and doors five feet wide. The doors open in opposite directions, and when one is opened it closes the aisle, so that hogs can be changed from one pen to another by simply opening two doors. Each pen is provided with a trough, and near the center is a force-pump, supplied with a rubber hose long enough to reach to any part of the pens. With this apparatus, Mr. Lockhart informed me, he thoroughly cleaned his pens once a week. The cobs are scooped up and taken out daily, with all other refuse matter, and dumped out to the stock-hogs, which are fed in adjoining lots, each lot containing fourteen acres. One of these lots is planted to soft maples and the other to black-walnut trees, the trees now being about seven years old.

Mr. W. W. Woodyard, Morristown, Shelby county, says:

We have no disease affecting farm-animals in our locality, except cholera among hogs, or a disease making its appearance in many different forms, called cholera. In some cases the pig, when quite young, will become affected about the eyes, and partial or total blindness will follow in a few days. A high state of inflammation about the mouth and throat next makes its appearance. Perhaps 90 per cent. of such cases will prove fatal in from six to ten days.

In other cases the hog, at a greater age, will first show signs of inflammation about the ears and neck, the ears becoming sore, with a yellowish mucus making its appearance about the root of the ear. Very few of those attacked in this manner recover. Some will simply show a sleepy, sluggish appearance, refuse to eat, and usually die in from twelve to twenty-four hours.

Many remedies have been used, but the best informed men will say, almost unanimously, without the least benefit whatever. The disease is prevailing to a fearful extent in some localities at this time. The president of the First National Bank at Rushville, Ind., who has large opportunities of knowing, says that Rush County alone will lose $500,000 by this disease the present year. Our own county will perhaps be equally as heavy a loser.

Mr. A. H. McCoy, Gentryville, Spencer county, says:

In answer to your inquiries I shall only notice the diseases affecting hogs. I have been a breeder of hogs for forty years, and during that time have never known any disease among swine so fatal as cholera. This county loses from ten to twenty thousand dollars per annum by the disease. As I have been a breeder of fine pigs for more than twenty years, I have been unusually interested in the diseases of swine, and have been able to guard against every other disease but cholera. Mange is generally engendered by filthy quarters; thumps by general debility, mostly for lack of healthy feed; but cholera, beyond reasonable doubt, is a contagion, and is carried from herd to herd by hogs affected with the disease. Near twenty-five years ago, when the cholera first made its appearance in our county, I discovered it was nearing my neighborhood, and as it was very fatal, and fearing it was contagious, I fenced about six acres in on the inside of my farm, some eighty or one hundred yards from any outside fencing. The result was, I did not lose any of my thirty-five head, though my nearest neighbors lost from one-half to about all their hogs. Since that time my observation and experience have been the same.

Last winter I lost over twenty head of fine Berkshire hogs and pigs, caused by a gang of hogs affected with cholera being driven into my immediate neighborhood for

the purpose of feeding on the mast, which was abundant. The symptoms, &c., are as follows:

1. A cough which lasts two or three days, and a strolling, restless disposition.
2. Vomiting, which generally lasts about a day; hog very sick.
3. Purging, generally, but not invariably, lasts two or three days.
4. After the purging ceases, if the hog is likely to recover it will generally eat a little; but those that ultimately die seldom eat anything after the vomiting sets in. Those that die usually do so within from forty-eight hours to ten days.
5. After vomiting sets in the hog has a high inward fever, accompanied with chilly sensations, a symptom I discovered by observation. Snow was on the ground last winter, and it was very cold at the time my hogs were dying with the cholera. Very often they would leave their beds for the purpose of eating snow, which they would continue for a long time, though they had plenty of water; then they would pile together and shiver, which they will do even in warm weather if they have the cholera.

As to remedies, I have tried a number of the most popular ones without any favorable results; indeed, I am satisfied there is no cure. The best preventive beyond all doubt is the fencing-in system—*let no hogs run at large.* The next is the scattering system—have but few together. Farmers lose on an average about one-half the number of their hogs whenever the disease gets into a large herd.

Mr. PERRY K. COLTON, Moorefield, Switzerland county, says:

The only disease prevailing here among farm-animals is that among hogs, and known as cholera. There has never been a case of it in my neighborhood, but much of it has and does exist in adjacent communities. The first symptoms are languor, watering of the eyes, diarrhea, in some cases constipation, and a dry cough near the close of the scene. The duration of the disease is from one to two days. The average fatality is virtually all, for the few that do recover are afterward worthless. No remedies, so called, are used with any success whatever. Dissection after death discloses, in many cases, the bowels much inflamed. Often the intestines contain large numbers of white worms, which in some cases are so knotted together as to completely obstruct the bowels. The lungs are generally found much decayed and otherwise affected. Soap, black antimony, wood-ashes, sulphur, &c., are given as preventives, but with what success would be difficult to determine.

We are of the opinion that the disease is a blood poison somewhat of the character of malaria. With us, where malarious diseases prevail in the human family, the cholera is mostly found, and where there is no ague or other malarial disorders there is but little or no cholera among hogs.

Mr. G. H. LUCAS, State Line City, Warren county, says:

A prevalent and fatal disease among hogs in this locality is known as cholera. The first symptoms are running off at the bowels, which is generally accompanied by a hacking cough. The animal becomes stupid and refuses to eat. As the disease progresses it becomes very poor and emaciated, and stands around with its body drawn up as if in pain. The disease usually proves fatal in from one to four days. The following remedy for the disease has been used with moderate success in this neighborhood, viz:

One pound each of sulphur and madder, one-half pound of saltpeter, one-fourth pound of antimony, and one ounce of asafetida. This should be mixed with a pailful of slop or milk, and three tablespoonfuls given once a day.

I am satisfied the disease is contagious, and all infected hogs should be removed from the well ones, and those that die should either be burned or buried very deep in the ground.

Mr. LEWIS J. REYMAN, Salem, Washington county, says:

We have no prevailing disease among farm-stock in this county, except hog and chicken cholera, which has prevailed for quite a number of years, and is prevailing to some extent at this time. Two years ago this fall I turned thirty-five hogs of my own raising in a corn-field, and they fattened very fast for about three weeks. About this time I bought twelve head that were raised on low, wet, river-bottom land, about twelve miles from my own land. In a few days some of them were attacked with cholera, and two died. In a few more days those of my own raising took the disease, and nine of them died. The balance lost flesh for a time, but gradually recovered. I fed them sulphur and ashes, calomel, May-apple root, and a number of other remedies recommended.

There are various symptoms of the disease. In some instances they vomit and purge, and in others their lungs seem to be affected, and they are constipated. When the lungs and bowels are affected they seldom if ever recover. Those that are attacked with vomiting and purging get well, and soon go to fattening again.

The same fall (two years ago) I had thirty pigs that were just weaned. They were

taken with purging, and all died. I also had about thirty spring shoats that were affected in the lungs and bowels. They all died but four or five. Two lingered for some days and would not eat grain, but would drink a little milk. I concluded I would experiment a little with these, and I gave them each one tablespoonful of sulphur every morning in their milk for two weeks, when they commenced eating corn again, and gradually got well.

IOWA.

Messrs. M. K. PRIME & SON, Oskaloosa, Mahaska county, say:

The breeders and pork-producers of this locality have been troubled a great deal with what is termed "hog-cholera." In pigs the first symptom of the disease is a cough. Some of them, if let run a few days or a week or two, will be attacked with the "thumps." This is the first stage of the fatal disease of cholera. The next symptoms are stupidness, loss of appetite, inclination to lie in their nests, great thirst, and continuation of cough. Some will purge freely until all nutriment seems to have passed from them. The urine becomes very red, and a slimy excrement passes from the bowels. They live but a few days after these symptoms are manifested. The symptoms of the disease are about the same in more aged and full-grown hogs. Our opinion is that the disease is caused by feeding too much rich food, and then a sudden change on to pastures. Overfeeding also produces disease. The diet of a pig when first commencing to eat, and also that of the mother while suckling, should be of light, easily-digestible food, containing sufficient nourishment to sustain them well. Should the pigs take cold and commence to cough, give them a small amount of Glauber salts, sulphur, and ginger, or something that will produce a similar effect. Farmers generally use, and with considerable success, salt, wood-ashes, soapsuds, or small quantities of soft soap.

KANSAS.

Mr. R. A. STEELE, Lawrence, Douglas county, says:

In reply to inquiries in regard to diseases among farm animals in this neighborhood, I would say that the most serious is a disease among hogs, commonly known as "hog-cholera." In October, 1876, I had on hand seventy-five hogs, averaging 115 pounds per head, for the purpose of feeding with or following cattle. They were mostly of the Berkshire breed, and seemed in fine condition. The feed and water were good. In December they commenced coughing, and soon after dying, until I lost over half the number. I finally turned them out in a corn-field which contained some wet ground, in which they spent most of the time rooting. The disease was arrested, and no more of them died. They visited some of my neighbors' hogs, but did not convey the disease to them. I examined several of those that died, and came to the conclusion that the lungs were affected.

I found the same disease existing among hogs throughout the country. I do not regard it as the same disease of which so many hogs died in 1873 and 1874. I think they were affected with worms.

My opinion is that hogs are forced, and fed, and bred too young—a mushroom growth. As a remedy, we should use matured sows and males for breeding, and allow them to run in pastures. They should not be fed and fattened until a year or eighteen months old. To insure healthy meat and do credit to the hog product, such a system must be adopted.

KENTUCKY.

Mr. W. E. GRANT, Carrollton, Carroll county, says:

We are troubled more in this immediate locality with the loss of hogs than any other class of farm animals, and my observations have been confined chiefly to the progress of the disease called hog-cholera, and as it relates more nearly to young pigs from four to twelve weeks old. Among the first symptoms are shivering, slow and careful movements, and a desire to remain almost constantly in the warmest sleeping place they can find. They eat very little. In those that are not weaned, and in some that have been, a thick wax collects on the eyelashes and fastens the lids together. On opening the lids by force the ball of the eye appears perfectly white, and is entirely devoid of sight. The discharge from the bowels at first is like thin wheat-flour dough, but toward the latter stages of the disease becomes quite black, and has a very offensive odor. Coughing is very frequent—often one of the first symptoms. The attack lasts from five to ten days, sometimes longer. Should any apparently recover, they rarely ever become of any value.

No remedies have proven beneficial to young pigs, though many have been tried. If the brood-sows were kept in perfect health the pigs most likely would not be attacked. The most successful treatment for preventing the spread of the disease that has been

tried here is as follows: Remove all affected ones from the drove as soon as the first symptoms are observed. They had better be killed and buried, but may be put in a remote lot by themselves. Change the diet of the well hogs as much as possible; keep by them at all times a mixture of coal-ashes (seven parts), ground sulphur (two parts), and one part of pulverized copperas. All the coal-ashes and fine coal that the hogs will eat should be given to them.

With all the light we have on the subject we are still very much in the dark, and some farmers have become so much discouraged in their fruitless efforts to arrest the disease when it once gets among their hogs that they have given up swine-raising in disgust.

Dr. R. J. Spurr, Lexington, Fayette county, says:

Ten or twelve years ago a committee of physicians was appointed by the Farmers' Club of this country to investigate the subject of so-called hog-cholera, then and now very prevalent here. The undersigned was one of this committee, and during the progress of this investigation a large number of *post-mortem* examinations were made, the subjects for examination being taken at all stages of the disease, from its incipient stage to its close in death. Copious notes were made of everything observed, but through the death of the chairman they have been lost, yet sufficient facts were impressed on the writer's mind to warrant him in bringing them to your attention. This malady among hogs is so well known that a description of its symptoms and progress is unnecessary. Suffice it to say that, whatever may be its cause, it does not occur in single cases, but when a herd of hogs is attacked by it but few escape. Pigs and small shoats seem more liable to it than older hogs. It also proves more destructive to the former than to the latter. As "there is nothing in a name," this disease had just as well be known by its popular name of "hog-cholera" as any other, although the name in many cases leads to doubt and hesitancy from the fact that looseness of the bowels is expected, when directly the opposite may exist. Purging may be present in one case, and constipation in another. In the *post-mortem* examinations made it was found that the lesions of the different organs were not uniform. The liver in one case would be found engorged or inflamed, and in another not affected. In another case the stomach would be found ulcerated or inflamed, while in still another it would be found in its normal condition. Some would have inflammation of the bowels, and others not; worms would be found in the bowels of some, while none would be found in others. There was one organ, however, in which the distinctive process was very uniform; indeed, in the forty or fifty cases examined I do not remember of a single exception. This was in the lungs, and is known as inter-lobular inflammation, and incident to the early stages of the disease. In more progressed cases there was no general diffused inflammation or hepatization. There was one other thing uniform in every case, and this was in the condition of the blood. This was placed under a microscope of rather feeble power, and the blood-disks or red globules were found to be changed from their normal configuration. In recent cases the number of disks found to be changed were limited, but very general in those where death had resulted from the disease. The blood-disk in the hog in its normal condition is nearly circular, has smooth edges, and when piled one upon another resemble somewhat small heaps of silver money without the milling around the edges. The change which had occurred was a shriveling or corrugation of the edges. Their appearance brought to my mind the scalloped edge of the bush-squash of our summer gardens. The cause of this we were unable to determine, from the fact that our microscope did not possess sufficient power for the purpose. We drew the conclusion, however, that they had been pierced or penetrated by some low order of organized life which we had not the facilities for detecting.

The writer is a farmer, and raises a considerable number of hogs annually, but he has not had the disease among his swine since the investigation detailed above, although it has prevailed to a considerable extent upon adjoining farms, and in a few instances diseased hogs of the neighborhood have mixed with his herd. He has persistently pursued a course of prevention, which may or may not have been the cause of his exemption. His course has been to give his hogs salt and sulphur once a week in the proportion of two of the former to one of the latter, always giving them as much as they will eat. They should have it both in summer and in winter, and without any regard to weather. In addition to this he uses wood-ashes freely, upon piles of which he throws salt. He has pursued this course with the hope of preventing the disease, as sulphur is destructive to low orders of animal and vegetable life.

Mr. N. A. Caulter, Mayfield, Graves county, says:

The only disease prevalent among hogs is cholera. We suffer greatly in this region from the ravages of this disease. At least 40 per cent. of those attacked die. A great many supposed remedies have been tried, but none appear to do much good. The fatality among sucking pigs is greatest, as about all that are attacked die. I believe the best remedy that has been used is a mild cathartic, such as castor oil or Epsom salts. The animals should have dry, comfortable quarters.

Mr. S. C. JACKSON, Laurel Bridge, Laurel county, says:

There is no fatal disease existing among farm animals up here in this mountainous part of the State, except among hogs, and that is known as cholera. I know of no sure remedy for the disease, but I am satisfied from an experience of over fifteen years that there is a preventive, as I have successfully employed it for that length of time. I take a tub or cask and place it in some convenient place, and into this I throw all the scraps of meat, bread, and other refuse from the table, and also the dish-water. About twice a week I add some meal or bran, and then let it stand until it sours, after which I feed to the hogs two or three times a week. I give them about the quantity I think they will drink, and in warm weather, if the dish-water is not sufficient, I add water from the well or spring. I have never lost any hogs since using this mixture, while those of my neighbors who do not use it lose more or less every year.

Mr. WILLIAM S. RAND, Vanceburg, Lewis county, says:

Hogs being the staple product and source of the principal revenue of this county, I have given special attention to their treatment and the diseases to which they are incident. In the limestone sections of this county the fatality of diseases has been most disastrous. Hog-dealers have tried all the remedies and practiced every kind of treatment. In herds where an animal has died those remaining have been separated and quartered in small lots in distant localities, and this treatment has generally been more successful than any other. The symptoms of the disease are widely different, and what will cure one would seem to kill two. Sometimes temporary relief may be obtained, and the animal apparently be in a fair way of recovery; but in all probability in a day or two afterward it would be found in a dying condition. Mr. Brazil Lyle, a hog-raiser in the mountains, has been successful in treating the disease with the free use of coal-oil, given in half-pints and by injection. The same remedy has failed elsewhere. Capt. Jack Henderson, who has had large experience in the treatment of the disease, has arrived at the conclusion that it is incurable. He has tried all the remedies, but his losses have been very heavy.

It has been stated and generally credited that the mountain or mast-fed hogs escape this disease. In order to satisfy myself on this point, I this fall made a protracted trip to the mountains of Eastern Kentucky for the purpose of observing the operations of the disease in the very highest altitudes of the State. In two instances the whole of two herds of fat hogs, ready for the market, died within two days, shortly after my arrival. They had previously shown no symptoms of the disease. Other lots, in the same neighborhood, showed no signs of disease.

It is most painful to witness the disastrous results of this mysterious and fatal disease on the young farmers of the interior. They grow a crop of corn to feed to hogs, buy the hogs generally on credit for a few months, and then, when they are almost ready for the market, this scourge comes along and carries them all off. The farmer is left without corn or other supplies for his family, and is also in debt for the hogs which he has lost. I could name several instances where the wolf is now at the door of many of the hard-working, honest farmers of this section, and if it is within the means of your department and the agency of the national Congress, in the name of God and humanity push forward the work for the speedy relief of the great producers of the land.

Mr. Z. T. MILLER, Raywick, Marion county, says:

Hog-cholera is the most destructive disease we have to contend with here in Kentucky. It will attack a lot of, say, one hundred head of hogs, and in two or three weeks it will not leave a victim to prey upon. The disease is more general and much more fatal in some localities than in others. A gentleman living in Nelson, an adjoining county to this one (Marion), has not had a case in a lot of two hundred head of hogs, while his neighbors have lost from three hundred and fifty to four hundred head. Why should this be the case? Perhaps feeding has something to do with it. Upon inquiry, I learn that the gentleman whose hogs have escaped the disease feeds cooked meal, in which is mixed wood-ashes, char and stone coal, sulphur, copperas, and coal-oil. This has been a successful preventive. His neighbors, who feed nothing but dry corn, have suffered severely. Dry corn is too stimulating, and produces fever. This is soon followed by loss of appetite, and the next symptoms are those of cholera. It is then too late to commence drugging them, as they are almost sure to die. However, a few might be saved if the sick were separated from the well ones as soon as the first symptoms of the disease were discovered. If hogs liable to infection were fed on cooked meal with the mixtures above named, I am inclined to think they would escape the disease.

Mr. W. T. PACE, Centre, Metcalfe county, says:

There is no disease among farm stock in this section of country, except among hogs. The disease prevailing among this class of animals has been very destructive. There

has never yet been a remedy found that seemed to do much good. Mandrake-roots and red-oak bark, boiled down to a strong decoction and given freely, is the best remedy that we have found. The hogs are attacked in different ways. Generally an eruption of small red pimples breaks out over the entire body, but are most prominent on the breast and belly; their breathing is accompanied by a wheezing sound; their bowels are inclined to be too active. At least 90 per cent. of those attacked in this way die. Other symptoms are manifested by thumping in the sides of the animal. The hog becomes stupid, and will refuse to eat or drink anything for several days. This is not a very fatal disease. There is still another phase of the disease, in which the bowels are constipated. In those examined after death the fæces matter is found in hard, round lumps, the size of walnuts. It seems impossible for them to have an operation of the bowels. They live but a few days, and seem to suffer a great deal. Epsom salts, cream tartar, and castor-oil are the only remedies that have ever done any good. The mortality is about 80 per cent.

Mr. J. D. McClanahan, Falmouth, Pendleton county, says:

The best preventive that I have tried for hog-cholera is soda-ash and barilla. I give a tablespoonful of this mixture to every six hogs. The way to prepare the mixture is to put the drugs in a kettle, add two or three gallons of water, heat until the medicine is dissolved, then make bran mash with the water. One dose a week is sufficient to keep hogs in a healthy condition; however, last fall I found it necessary to give my fattening hogs a feed of this kind every day, for the reason that some of them showed continued symptoms of disease. I lost but one out of thirty-three, and that one died on the same day that I put them up to fatten.

Mr. J. D. Guthrie, Shelbyville, Shelby county, says:

Hog-cholera, in its incipient state, with shoats and half-grown hogs, usually begins with constipation, a symptom easily discoverable by their droppings, which are hard and marble-like. This is followed by a dry, hacking cough and internal fever, which increases as the disease progresses. These symptoms are attended with a gradual loss of appetite. At this stage of the disease their movements become listless; they droop their noses toward the ground, and are shy of approach. The duration of these symptoms depends upon the severity of the attack. In some cases they continue six or eight days, and in others two or three weeks, with gradual loss of flesh until they look like walking skeletons. I refer now to the premonitory symptoms. After the disease becomes epidemic they frequently die within twenty-four hours after the first indications manifest themselves, without any regard to flesh or previous condition. In the latter stages of the disease they have a loose, discolored discharge, which soon terminates with thumps. This is a palpitation in the flank at the drawing of each breath. At this stage the disease is easily imparted to others, having become epidemic in form, and so fatal as to carry its victims off within a few hours. The remedies that prove efficacious in the first stages of the disease are worthless in the last. I would here recommend the removal of the diseased hogs from the rest of the herd, and the remedies hereafter mentioned given to the remainder. From my standpoint I am of the opinion that cholera in swine, in the last stages, is incurable, unless it be in isolated cases. I hold that constipation of the bowels is cholera in an incipient state, and whatever remedies would remove the cause the effect must necessarily follow. I speak only from my own experience and observation, which practice has fully demonstrated to be, in the main, correct.

I have been very successful in relieving my herd of constipation by giving one-half pound of calomel to fifty shoats, on corn moistened so that it would adhere to the grain. This should be repeated at intervals of twenty-four hours, until the bowels are opened by the medicine. Old bacon, grease, or linseed-oil will have the same effect, the only difference being that calomel will regulate the liver, while the others will only relieve constipation. Grease or linseed-oil, if given in doses of one-half pint, will cure thumps, which is the last stage of cholera in a constipated form. Hogs fed on apples, pumpkins, or following after cattle fed on corn, are not liable to cholera. A neighbor last spring purchased one hundred head of stock hogs from the pens at Louisville, Ky. Soon after getting them home they commenced dying at the rate of four or five per day. He procured a large kettle and commenced cooking and feeding the dead to the living hogs. The result was that he saved sixty out of the lot of one hundred. Others have fed the dead carcasses of sheep, cattle, and horses to hogs affected with cholera, and the result was a cessation of the disease. Another acquaintance keeps his hogs well supplied with wood-ashes and salt, at the rate of two parts of ashes to one part of salt, which he says is a certain preventive. As all these remedies have the same tendency, namely, the opening of the bowels, we can consistently arrive at but one conclusion, and that is that the premises are correct and the applications act as an antidote to the disease known as hog-cholera. I sincerely trust your inquiries may result in the discovery of something that will stay the further progress of a disease fraught with so much injury to the agricultural interests of our country.

Mr. M. M. SLOSS, Simpson county, says:

We have never had any serious diseases among any class of farm animals except among swine. Each of two distinct forms of disease destroys our hogs every year. One is called cholera and the other measles. The latter shows itself on the skin in sores and scabs. It is claimed by some of our farmers that sulphur, given internally, will effect a cure if it be given in sufficient quantities. Cholera is much the more fatal disease of the two. Generally the first evidence of its existence is the refusal of the hog to eat. Its ears will flap down over its eyes, giving it a dull, sleepy appearance. As the disease advances its breathing becomes hard and is accompanied with a symptom similar to thumps in horses. Usually its bowels are constipated, but sometimes they may be lax, and occasionally vomiting may occur. In a *post-mortem* examination of one case the entire intestine, and all it contained, were found to be very dry.

Few people attempt to cure a hog after the disease has taken hold of it. A number of practical farmers in this end of the county have used crude petroleum as a preventive for the past six years, and are established in the belief that if regularly and properly used it will keep them healthy. We buy it by the barrel, confine the hogs in a pen, and with a common tin sprinkler saturate them thoroughly from head to foot. We give it internally also on corn. Those of us who have tested its merits have great confidence in it, and in consequence have but little dread of the cholera. Where it has been used for six or seven years past the disease has not prevailed, notwithstanding its prevalence and destruction around us. As I feel interested in the welfare of those engaged in agriculture, I hope you will pardon me for pressing upon your attention the value of the above article as a preventive of diseases among swine. I hope you will have its merits thoroughly tested.

Mr. J. B. KENDRICK, Monticello, Wayne county, says:

We suffer here mostly from hog-cholera. It is impossible to give any diagnosis of the disease, for it manifests itself in numerous ways. I have seen them linger for months and ultimately recover, while others would die very suddenly. Again, I have seen them in apparent good health, and, while eating, suddenly jump up, squeal, and fall over dead. Hogs turned on the mast or acorns last winter did very well apparently, but when killed many of them were found to be affected with worms. In numerous cases worms an inch or more in length had penetrated the heart and bowels. Cholera has generally been worse among our hogs after a good mast-year than any other time.

MARYLAND.

Mr. W. P. DORSEY, Port Republic, Calvert county, says:

During the past autumn, commencing about the 20th of September, a disease attacked the hogs of a gentleman in this county, which proved quite fatal. It disappeared late in December. As far as I have been able to learn, the principal features of the disease were about as follows: The most constant symptom was weakness in the hind legs, which, in two or three days, rendered the animal unable to stand. Soon there was entire loss of appetite, frequent shiverings, and after the first week or ten days considerable of a cough. These symptoms increasing would end in death, sometimes within a few days, and in others continuing for weeks. Diarrhea was marked in only one case; delirium was prominent in but one instance. The solitary animal that recovered lost all its hair during convalescence. *Post-mortem* examinations, not made by competent observers, revealed nothing constant or apparently sufficient to account for the symptoms. In one case there was marked enlargement and congestion of one kidney, but this was wanting in the others. In some cases there was peritonitis and inflammation of the intestines. Out of a herd of twenty-three hogs ten were sick, and only one out of the ten recovered. None of them seemed to thrive during the existence of the disease. An entire herd of twenty-six pigs, from one to four months old, died. There was no apparent cause.

MICHIGAN.

Mr. M. B. HINE, Austerlitz, Kent county, says:

Last spring there was a general fatality among the young pigs, and in some instances with the autumn pigs in the latter part of the winter, there being no apparent sickness discovered prior to their death. At least such was the case in this immediate vicinity; but I noticed that this all disappeared as soon as the hogs were turned out to grass. The conclusion I arrived at is, we must furnish a greater variety of food for our hogs during our long winters, particularly of roots and vegetables, instead of feeding all corn, as is usually the practice with most Western farmers.

Mr. H. SEVISON, Constantine, Saint Joseph county, says:

We have had no diseases among horses, cattle, or sheep for several years past; but our hogs have been seriously affected with what is generally known as cholera. The disease has been a very peculiar one here. Some were affected in their hind limbs, others in their fore legs; some died very suddenly, while others would linger for months, and, after becoming mere skeletons, would lie down and die. The loss has been very heavy. No cause for the disease has as yet been discovered or remedy found. Some have thought that pure. clear water would prove a preventive, but such is not the case.

MISSOURI.

Mr. N. B. PETTS, Lincoln, Benton county, says:

There is no disease existing among any class of farm animals except among hogs, and among this class of stock there are several diseases, viz: measles, lung-fever, cholera, and worms. In this vicinity and throughout this county measles has prevailed to an alarming extent, and probably more hogs have died from it than from all other diseases combined. But nearly every farmer designates the disease as cholera. In measles the hog refuses to eat, lies much of the time in his bed, goes often to water to drink, but not to wallow, and grows poor very fast. The hog has a slight hacking cough. If the eruptions break out thickly all over the body the animal generally gets well; but if they do not, or after breaking out they should go back, the hog dies. There is a very offensive stench about their sleeping-places. Everything kept in a drug-store, and in quantities to astonish and alarm an allopathic physician, has been given, and the wonder is that so many have lived. All kinds of food have been given, but with no apparent beneficial results. The only thing claimed to have done any good whatever was a tea made from peach-tree leaves, limbs, or bark. This brings the measles out thick, and if the hog has a dry bed and is kept from water the chances are in his favor. The bowels should be kept open, and not more than five or six should be confined in the same pen.

For worms we give a teaspoonful of turpentine once a day for a week. From one-half to two-thirds of all hogs affected with diseases have died. I doubt if any have died of cholera.

Mr. F. M. CUMMING, Harrisonville, Cass county, says:

This immediate vicinity has suffered immensely from the ravages of the disease known as hog-cholera. During the early part, and indeed almost entire winter, it disappears or scarcely makes an appearance; but during the months of March and September it breaks forth in most fatal forms, frequently causing the death of every hog on a farm. I have known as many as sixty and eighty to thus die in one week on a single farm, leaving not one to commence restocking with. The disease assumes two forms. The first, and what I presume to be cholera proper, commences with black discharges from the bowels, which continue until the animal "wears it out," or becomes a gaunt skeleton, and dies from mere exhaustion. The second form commences with an utter refusal to eat, stupid appearance of the animal, high fever, very constipated bowels, and a great desire for cold water. This form generally proves fatal in three or four days. When dead, blood gushes from the nostrils, and upon examination the lights resemble coagulated blood of the consistency of cream. This disease causes greater losses to the farmers of this corn-producing country than all other diseases affecting farm animals combined.

Mr. J. L. IRWIN, Fulton, Callaway county, says:

Except hog-cholera (intestinal disease of swine), domestic animals in this portion of the country for the past year or more have been remarkably free from disease. On the 1st of March last I moved a lot of healthy hogs on to the farm on which I now reside, where there had recently been diseased hogs. In about two weeks disease broke out among them, and nearly all of those attacked died within from five to ten days. * * * The disease may be said to have been general during the fall of 1876, although a few farmers escaped entirely. In a few localities quite a number of hogs have been lost this fall, but I am not advised as to the nature of the disease.

Mr. WILL C. RANNEY, Cape Girardeau, Cape Girardeau county, says:

While I have no pretensions to a scientific knowledge of diseases of farm animals or their treatment, it has been my misfortune during the last twenty years to witness much of the so-called hog-cholera, and that length of time will, I think, embrace the period of its prevalence here, as prior to that time I heard nothing of it. I have had a residence here of fifty-three years. I have known the disease to rage here among swine under all circumstances and conditions in which swine are kept. I have known it to destroy droves of hogs of the common kind, others of no breed at all—such as run

in the swamps and never saw corn. I have known the same breed and quality of hogs destroyed that run in the woods around the farm with free access to running water and corn sufficient to live on. I have known them to die in cleanly pens, where they were well cared for, as rapidly as in filthy sties. I have known them to die of the disease in woods lots, where they were fed regularly and abundantly twice a day on corn. I have known them swept off by the scores in a grass pasture, while others in an adjoining clover field escaped; while at other times the clover pasture afforded no better protection than other places. Nor have those who pay the greatest attention to fine breeds of hogs and their cleanliness and comfort fared any better than those who pay no attention to either.

When the disease first made its appearance among my hogs, I was in the habit of placing the diseased animal on its back and pouring a tablespoonful of powdered copperas down its throat. Every animal thus treated at that time got well. The same treatment the past season was without any beneficial results. I know of but one animal that recovered during the past summer, and it was treated to a copious administration of pine-tar poured down its throat.

The hog-cholera presents itself under so many different phases that it would be difficult indeed to describe it. Each farmer in this vicinity would no doubt give a different description of it as it prevails among his own stock. Sometimes the animal will vomit and purge; sometimes one of these symptoms will be prominent and the other entirely lacking; sometimes neither will be observed, but the animal will apparently be affected with sore throat. At other times sores will appear all over the body, occasionally causing the loss of the animal's eyes or ears, and not unfrequently both. Sometimes the most prominent symptom will be thumping, as a horse affected with the thumps.

I am satisfied that a knowledge of the cause or causes of the disease has not been discovered, and I can but hope that the investigations making by your department will result in finding either a preventive or a cure for this frightful and fatal disease.

Mr. H. L. W. Rogers, Lathrop, Clinton county, says:

In reply to your circular letter I will only speak of hog-cholera, as that is the only disease from which I have suffered much loss. I regret to say that I have made poor progress in doctoring my hogs. The first symptom of the disease is a cough, which is soon followed by loss of appetite, and by vomiting and purging, though not always. They would also draw up very much in the belly. The duration of the disease was from ten hours to three days. Occasionally they would be attacked by "thumps," with no other cholera symptoms, and in such cases they would live for weeks, but finally die. In the fall of 1875 I lost twenty hogs out of a herd of 135. About all that were attacked died. I examined three and found the bowels full of worms; I also found the bowels and small intestines full of little sores, which were no doubt caused by the worms. The lungs and paunch were much inflamed. I drenched one with spirits of turpentine weakened with milk, and it died in less than five minutes. Since then I have fed my hogs liberally with wood-ashes, sulphur and copperas, and have had no more cholera among them. I salt twice a week, mixing the salt with unleached wood-ashes, and about once a month I give pulverized copperas and sulphur for the purpose of driving the worms out and the lice off of them.

Mr. A. C. Snyder, Glen Allen, Bollinger county, says:

There is but one class of domestic animals in Southeast Missouri subject to epidemic diseases, and that is swine. Occasionally we lose a few cattle, but the number is so small that we fail to locate any special disease. But we are accustomed to lose a great many hogs every year, and last year we lost fully one-half of our entire stock. The diseases among hogs have not been given the attention their importance demands, and we really know nothing as to the treatment required. I can therefore only give you the more prominent symptoms, and a few facts in regard to the fatality of the diseases.

Hogs of all conditions seem to suffer alike—those that are well fed and well housed suffering alike with the poor and neglected animals. The disease generally makes its appearance in the early summer and continues up to the end of the year, at which time there are but few hogs left. It first occurs in the vicinity of and in the valleys, and along the small creeks, where it always proves most fatal. Farmers on high lands are, therefore, more successful with their hogs than those living along creeks.

I have noticed two distinct diseases affecting swine. In one, the hog seems to have no desire for food; appears sick inwardly; is given to alternate constipation and scouring; vomits frequently, and grows very thin. These symptoms culminate in death within from five days to two weeks. The prominent characteristic of the other disease is the loss of the use of the animal's limbs. Notwithstanding it finally loses the use of its legs completely, so that it is unable to stand up, its appetite continues good. These symptoms occur more frequently among fattening hogs. This disease generally proves fatal within from two to ten days. No intelligent treatment has as yet been

discovered, although many think they have an infallible remedy. I think at least 50 per cent. of the hog-crop of this county has been lost by disease during the past year.

Mr. JOHN B. GLAGE, Glenwood, Schuyler county, says:

We have among the swine of this county a new and very fatal disease. We have no name for the malady. The animal will eat heartily to within a few hours of its death (say six hours). A *post-mortem* examination shows the heart, liver, and kidneys to be completely decayed; so much so, indeed, that they will not hold together if taken in the hand. The stench from the dead animal is simply unbearable. No remedy for the disease seems to have been discovered. Hog-cholera is also still raging in this county. We have no remedy, and about all the hogs attacked die sooner or later.

Mr. A. K. GOODRICH, Quincy, Hickory county, says:

I have been a hog-raiser and a close observer of their habits for over forty-five years. The disease so fatal to swine was discovered as existing in this county and neighborhood in March, 1876. Within very few weeks my neighbors lost from $300 to $700 each by the disease. Knowing that I was a great lover of this class of stock, my neighbors, whenever they would meet me, would say, "Well, Goodrich, are any of your hogs dying of cholera?" I would answer, "No; and I don't intend that they shall as long as an ounce of preventive is worth a pound of cure." When I would tell them what I was doing, they would say that they did not believe in it. But I persisted in the use of preventives and lost but one hog, while they lost a great many. The preventive I used with such beneficial results was composed of the following articles, viz: Two pounds sulphur, 1 pound black antimony, 1 pound copperas, and ½ pound each of saltpeter and salmiac. This was put into a forty-five gallon barrel, sunk half way into the ground, and which had previously been filled with fresh water and good corn-meal. To this preparation I would add more or less soot as often as I could get it from the stove. I fed them from this barrel twice a day. Sometimes I would omit the drugs for a week, and then fill up fresh again. I kept twenty hogs in this way. One was taken sick in June and drooped around for a month. It preferred being in dark, shady places, where it remained most of the time alone. It recovered before July had passed. I then thought I was clear of the disease, as I had watched its progress carefully and had never known it to enter a herd the second time. But I was doomed to disappointment, for soon three more were taken sick. Two of these lingered for a long time, and one of them became a walking skeleton. Neither one of them would eat for several days. This they did after a while, however, and they finally recovered and made good hogs. The third one died. It was a very handsome hog, and in good order. If it had been dressed and taken to market it would have been regarded as first-class pork. I dissected it for the purpose of discovering, if possible, the cause of its death. Not one organ of the whole body seemed to be affected except the lungs. They had assumed a bluish-purple color. I am satisfied that the flesh had not partaken of the disease, and I also entertain the opinion that three-fourths of all the hogs slaughtered for pork that year were affected with the disease.

The disease is very severe on pigs. Out of forty-two head affected, but one was saved. They were not given my preventive.

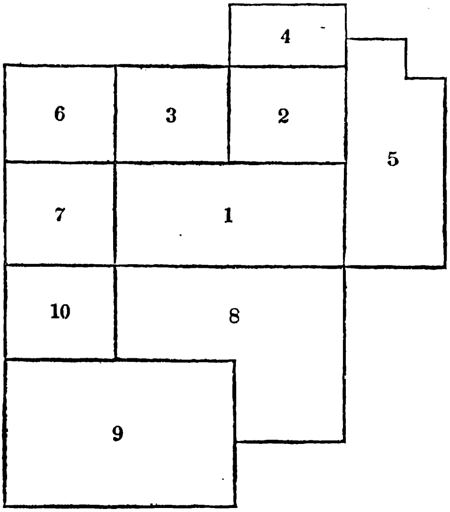
I helped a neighbor slaughter his hogs. Up to the time of slaughtering there had been no sign of disease among them. It fell to my lot to take out the entrails, every one of which showed more evidence of disease than mine which I had dissected. In less than ten days after this those hogs he had left began to die off by the score. As the disease from which they died seemed to differ from other diseases existing here, I give the symptoms, as follows: They stand with drooped ears; walk but a few steps at a time, and stop very suddenly; seek isolation from the rest of the herd; lie on their bellies in dark, shady places, with their fore feet extended. During the latter stages of the disease they vomit a greenish and sometimes yellow colored matter. The skin on the belly, flanks, between the thighs, and behind the ears turns a bluish-purple color. Still later, the animals try to squeal, but make a faint noise, more resembling that of a sick child than anything else.

When in Sedalia, in October last, I met a Mr. H. A. Sharp, who told me he had discovered a positive cure for hog-cholera, and that he intended to get it patented. He gave me some for the purpose of having me test it. Shortly after I had a fine Magee male hog taken sick. He was so far gone that I had to pry his jaws open in order to administer the medicine. I gave him a tablespoonful in a little sweet milk, and it acted like a charm. In three or four days he was in his usual health. I have since given it to three small pigs, with like favorable results. The tincture has a dark wine-color, is pleasant to the taste, and smells strongly of peppermint and pennyroyal.

My hogs run in the woods, where they get part of their living; have access to fresh water, and get their food as regularly as if kept up. My experience is that they will contract diseases and die under all conditions and circumstances, in green pastures and in the woods as well as in close pens.

Mr. HORACE MARTIN, Corning, Holt county, says:

I have been a resident here nine years, and during that time no disease has prevailed among farm-stock, except a disease among swine. Raising corn and feeding cattle and hogs is the principal industry in this vicinity. During the last three years the losses among hogs have been greater than heretofore within the circle of my observation. There is a singularity about the spread of the disease which to me is unaccountable. Some years a farmer will lose nearly his entire stock, while his neighbor adjacent will remain entirely exempt from it. Then in a year or two the conditions will be reversed. I will give you the statistics of the last three years of this and adjacent sections, numbering the farms 1, 2, 3, &c., my locality being farm No. 1. Two years ago at this date (September 1) N. Rosalins, No. 9, lost 210 head of hogs out of his feeding-pens. He did not count the young shoats, which were not confined. No. 8 lost 30, but in a tenant's pen at his own feeding-yard he lost over 200 head more. Farm No. 5 lost 36; others none. Last fall No. 1 lost 57; No. 2, 80; No. 3, 45; No. 4, 64; No. 6, between 30 and 40; others none, or very few. This fall, in a herd of 150, I have lost none. Neither has 2, 3, 4, and 5, while 6, 7, and 10 have lost over 100 head. These were fattening hogs, not shoats, and weighed from 200 to 350 pounds.



The characteristics of the disease are various, although in numerous cases no symptoms of disease were observable. In the morning I would find hogs dead that the night before I thought were well; yet on examination I would find the lungs, intestines, and skin very red and engorged with blood, but I supposed it was a natural consequence of their dying with all their blood in them. Unless the hogs are quite young the liver is always found ulcerated and otherwise diseased. The first symptom noticed is reluctance to leave their beds. Rout them out, and they walk as though they were stiff. Their urine is highly colored or bloody. Possibly they may bleed at the nose; then they are sure to die in less than twenty-four hours. When found dead the nose is nearly always bloody. Sometimes the disease commences with a cough, panting at the sides and flanks, and a refusal to eat. They then linger along for a week or ten days, when they usually die. With the experience I have had with it, I believe it to be more properly a typhoid fever. There are numerous remedies for sale, held as secrets, yet I never see any good effects produced by them when used in a herd of sick animals. They may be valuable as preventives. For eight years past I have endeavored to keep up my herd to one hundred and fifty head, feeding from seventy-five to eighty each year. Except during last fall I have had no disease among them. I have dry, open sheds for them to sleep in, and feed them all the ashes we make, mixed with a little salt. Occasionally we mix several tablespoonfuls of sulphur, or about half as much copperas, with the ashes, say once or twice a month. We give them all the corn they will eat up clean.

Many hogs are dying all through this section of the country. This immediate vicinity has not, I think, suffered larger losses in comparison with the number of hogs kept than other neighborhoods in general. Yet this school district, comprising four full sections of land and two fractional sections bordering on the Missouri River, has in the last three years lost certainly ten thousand dollars' worth of hogs. Hence the aggregate losses in the State must reach high in the millions of dollars.

Mr. JOHN H. STEFFENS, Houston, Texas county, says:

The only disease prevalent among farm animals in this country is that of cholera among swine. During the past eight months 60 per cent. of the hogs in this vicinity have died of the disease. The first symptom of the disease is a swelling of the throat. The next is a wheezing cough, followed by running at the nose and loss of appetite and hair. A majority of them lose the use of their legs. They generally die in the course of about twenty-four hours. About 5 per cent. recover, with the loss of their hair. No remedies that have proved of any benefit have been discovered.

Mr. C. A. ADAMS, Chillicothe, Livingston county, says:

This year the diseases among swine have proved more fatal among young pigs and

fat hogs, farmers having lost from one to one hundred head. The remedies are so various and unreliable that they are not worth mentioning. It is very doubtful, indeed, if a remedy ever will be discovered until the sanitary condition of the hogs is improved. The animals are affected in different ways—some purge and vomit, while others cough violently. Some refuse to eat, and soon pine away and die. As the disease is most fatal in large herds and in filthy surroundings, it would seem to the interest of the farmers to look to the natural cause; and, if possible, to remove it by confining a less number together and keeping their surroundings clean. Feed charcoal freely, and on the first symptoms of a cough give one teaspoonful of red pepper to each one hundred pounds weight of the animal. Given in slop, it has proved very successful with me.

I have lost but few hogs since I removed them from the old straw-stacks, manure-piles, old sheds, and from under old buildings, where their quarters could not be cleaned out. A change of feed from corn will always prove beneficial among hogs when diseases are prevalent.

Mr. J. S. N. Newmyer, Lone Lake, Mason county, says:

Heavy losses have been sustained in this section by a disease among swine called cholera. There are several different diseases classed under this name, or else the disease has many different phases. I have been raising and fattening on an average about 100 hogs per year, and had very good luck until last January, when my animals commenced dying, and since then I have lost 200 head. I had 120 head on the first visitation of the disease, and out of that number lost 100. I did nothing to prevent the spread or to cure the disease—only separated the well from the sick hogs, but this seemed to do no good. Those first attacked died in a few days, and were full and plump when death ensued. After a few weeks they lingered along for a good while, and were generally reduced almost to skeletons before they died. The last ones that died had what we here call thumps, and they lingered along three weeks before they died. A very few recovered after they had become so poor and thin that they could scarcely stand. At the expiration of about two months I commenced buying another herd, weighing from 80 to 140 pounds each. I purchased them at different points, getting from six to ten at a place. After a little while they also commenced to get sick and die, and I lost 15 out of 46 in that lot. I used remedies with this herd, but do not think with any good results, although several of them recovered. Some of them had high fever, and others passed bloody urine. This was in May and June. In September following my pigs took sick, and in a very short time I lost 35 out of a herd of 38. These pigs were suckling at the time the disease broke out among them. They and their mothers were confined in the same lot with 40 hogs I was fattening, but none but the pigs were affected in any way. I have known several such cases in this neighborhood, and therefore I am not inclined to believe that the disease is contagious.

Mr. S. S. Smith, Bertrand, Mississippi county, says:

With the exception of swine, domestic animals of all classes are comparatively healthy. Hogs die at such an alarming rate that farmers have, in a great measure, quit trying to raise them for market. The disease is called cholera, although the symptoms seem to vary every season; therefore a remedy that proves efficacious one season does no good the next. A few years ago pine-tar or turpentine, fed with corn, was thought to be an excellent remedy; then copperas was regarded as the sovereign specific, but during the past few years we have not found anything that seems to do any good. Since turning my swine on wheat-stubble I have not lost one, although some of them were sick at the time.

NEBRASKA.

Mr. M. Stockton, Wahoo, Saunders county, says:

Previous to 1876 the swine of this county were healthy. The annual loss from disease probably did not reach 1 per cent. of the whole number. In the fall of 1876 the cholera broke out near Ashland, along Salt and Wahoo Creeks. During 1877 the disease has proven exceedingly virulent along all water-courses, and has baffled all remedies. In the beautiful valley of Wahoo fully 95 per cent. of those attacked have died. On uplands the disease has proven less virulent, many large herds having wholly escaped thus far.

NEW YORK.

Mitchell Brothers, Hannibal Centre, Oswego county, says:

There has been quite a heavy loss here incurred from a disease among hogs. We have no name for the disease, as there seems to be no definite knowledge concerning

it. Some people call it "black teeth." The first symptom noticeable is lameness in their hind feet. This continues until they lose the use of their hind legs entirely, after which they soon die. They have but little or no appetite after they are taken sick. There have been a great many hogs lost by the disease in this neighborhood during the past eighteen months. We lost five head ourselves last season. We sincerely hope some remedy may soon be found.

Dr. ANDREW J. WILLIS, Saratoga Springs, says:

The only disease that has prevailed here among farm animals during the past year was intestinal fever in swine (cholera). All cases proved fatal. The average duration of the disease was two days. No treatment seems to have been given. I saw none of the cases, and the only information I have I received from eye-witnesses. The symptoms and lesions described were those of hog-cholera. There were seventy cases in all. From the information I have been able to glean I am of the opinion that the disease was not of a contagious character; but I think unwholesome food contributed largely to its diffusion, if not to its development. The hogs were fed with food from the large hotels in this place, which usually contains a large per cent. of green vegetables, which, in warm weather, rapidly undergoes decomposition. I am informed that the feeding-troughs were never cleaned out, though swarming with maggots, and that the pens emitted a terrible stench. From this it will be seen that the swine were not kept in the best of hygienic conditions. The outbreak cannot be traced to contagious influences, nor can we say it appeared spontaneously, although we must concede that some cases probably originated spontaneously. No doubt the unwholesome food favored the development of the disease by loading the blood with deleterious organic matter, and so brought about a susceptible condition of the system.

Mr. FRANK D. CURTIS, Charlton, Saratoga county, says:

The diseases among pigs in this section of the country are limited in number and not generally fatal in their effects. No epidemic has ever raged among them, and such a disease as hog-cholera is unknown. But few pigs are kept. Most of the farmers winter but one or two breeding-sows, the pigs of which they fatten during the ensuing season. A few, however, winter a small number of fall pigs. Being limited in numbers, they have plenty of range and a variety of food, and are little liable to attacks of cholera or other contagious diseases. They are liable, however, to attacks of quinsy, pleurisy, inflammation of the lungs, and rheumatism.

Worm in the kidney.—There is a parasite which penetrates to the kidneys of pigs and causes them intense pain when they attempt to move. So severe is this soreness and pain that pigs affected will lie in their nests and starve rather than make the effort to crawl to the trough to eat. The presence of this parasite may be known by the reluctance of the pig to stand up and walk, and the apparent uselessness of the hind parts. Wash the back thoroughly with soap and water, and then rub it well across the loins with spirits of turpentine. A tablespoonful of turpentine should be given internally, and be repeated every day until the soreness ceases. Turpentine is a natural medicine for pigs and will not hurt them, as the fatty tissue readily absorbs it. A dose of turpentine may now and then be given to rid the bowels of any lurking parasites. Sulphur should always be accessible to them, as they are seemingly guided by instinct to consume it as an antidote.

Thumps, or heaving of the sides. This disorder is chiefly confined to young pigs running with their dams, and manifests itself usually when they are about four weeks old, although we have known instances where it was developed in a pig a year old, causing its death. The latest investigations seem to locate the disease in the lining membrane of the chest. We are inclined to think that it is owing to an excess of fatty matter about the heart, which obstructs its action. The pigs pant so severely that they make but little or no effort to nurse, and consequently rapidly become emaciated and die from prostration. We do not know of any effective remedy. It does not seem to be contagious, but the causes which develop the disease in one pig in a litter are very apt to cause the whole to be similarly affected.

Indigestion.—A pig is so constituted that when it cannot digest its food it will vomit it up and thus empty the stomach of its contents which otherwise might produce diarrhea. Suckling pigs, when the sow is overfed, often take more milk into their stomachs than they can digest, which produces diarrhea. The remedy is obvious—reduce the flow of milk by stinting the sow in food. In obstinate cases the young pig may be fed a few drops of laudanum or a little prepared chalk to check the discharge.

Dysentery.—This disorder is rare among pigs, but may be produced by feeding too much concentrated food, such as corn-meal, &c. We have known cases of dysentery to become chronic and run for a year, or until the hog died from weakness. Castor-oil is a natural and soothing purgative for a pig, and should be given in cases of constipation or dysentery, in doses of from an ounce upward, according to size; and in cases of the latter disorder it should be followed by astringents, in doses double that

which should be given to a human being. This is a proper rule in administering any medicine to a pig a year old.

Constipation.—This is a fruitful source of trouble with pigs, and is very common where they have been fed dry feed for a long time. Purgatives should be given when there are evidences of pain. By observing the feces, acute results may be obviated by a timely change of food to something of a more succulent character. Constipation is the cause of rage or craziness in sows at the time of giving birth to pigs. A heavy dose of castor-oil will relieve them, but it is much wiser and better to prevent such trouble by laxative food for a short time before pigging.

Apoplexy.—When hogs are in a plethoric condition they should never be worried or driven fast, or they may be attacked with apoplexy, which, of course, is a fatal disease. We have known instances of pigs dropping dead under such circumstances. The same causes which would produce apoplexy will cause abortion. A voracious consumption of pumpkin seeds will also cause abortion, and so will worrying by dogs, constipation, and severe fever.

Mange.—Mange is akin to scab in sheep, and is caused by the same insect, which burrows under the skin. The disease is superinduced in part if it does not originate by the favorable conditions of filth and scruff. Cleanliness of body is a prerequisite for the health of a hog, and the opposite condition is a natural stimulus to the breeding of lice, the production of mange, and the generating of tumors, fevers, and other disorders. Pigs are the most neglected and the most abused of any class of domestic animals. It is strange that such should be the case when they are reared only for human food. How any man can produce this portion of his food, reeking during its whole life with filth and nastiness, is one of the wonders before which we pause with astonishment. Mange also produces rheumatism, a painful disease, and one which unfits the animal for human food.

NORTH CAROLINA.

Mr. N. Atkinson, Asheville, Buncombe county, says:

There are no diseases prevailing among any class of farm animals in this county except cholera in hogs. Of this we have had a serious visitation during the past summer and fall. I only know of one party whose hogs are affected now. It is going through his herd at this time, and is taking off about one-half the lot. I lost eighteen or twenty during the latter part of summer and early fall. The first symptom of the disease was slight watering at the corner (lower) of the eye, followed by stupidity and loss of appetite. The effect on the animals differed greatly. I noticed some that died in less than twenty-four hours after being attacked, while others would linger for a month and then die. There seemed to be great constipation of the bowels. A fine Berkshire boar was affected differently from all the rest. His bowels were very loose, "run off" for near or quite a week, when he recovered, apparently but little injured. I have never seen anything that would do any good after the disease got a start, but there are several things that I think will prevent it if taken in time. I fed six or eight on poke root, which they will eat as greedily as potatoes if other food is not given too freely, and they never seemed the least affected. My impression is that the disease is first caused by worms and lice, and afterwards becomes contagious. If copperas and sulphur are freely used—say once in every two weeks—hogs will remain free of vermin, and then if kept away from diseased animals in all probability they will remain healthy. I once tried the experiment, and out of 100 head of hogs I did not lose one, and yet the disease prevailed to an alarming extent all around me.

Mr. J. N. Smalls, Scotland Neck, Halifax county, says:

We have but very few diseases among farm animals in this section of the State, with the exception, perhaps, of the disease known as cholera among hogs. This disease assumes different forms or symptoms. Some are attacked with vomiting, and linger about one week; others lose their appetite, become sleepy, and their eyes become inflamed and exude an offensive matter. Cases of the latter class have been known to die within six hours after the attack was first observed. Many remedies have been tried, among others salt and ashes, tar, saltpeter, and bluestone. While some of these remedies have proved of value on one farm, on an adjoining one they have been found of no service whatever. The disease is not so prevalent as in former years, though it is, perhaps, more fatal. One farmer has lost sixty-three head out of a lot of sixty-five.

OHIO.

Mr. L. H. Bonham, Oxford, Butler county, says:

This township has been peculiarly exempt from hog cholera. I attribute it to the superior care given to our swine. We ship large numbers of Poland-China hogs to all parts of the country, and our breeders vie with each other in the condition of their

herds. Frequent visitors to our farms have an influence which is felt and seen in the careful management of our pig-houses and farms. Every breeder takes a personal supervision of his stock, and watches them with an interest that no hireling can be inspired with. For this reason the first symptoms of disease are at once noticed and attended to. By such care epidemics have been avoided.

We now have a trouble that no one, so far as I have learned, has a remedy for. For want of a better name, we call it "sniffles," and when it has advanced so far as to cause a malformation of the snout of the hog, it is called "bull-nose." My observation of the disease would lead me to call it catarrh. It is like catarrh in human beings—in its insidious beginnings and tenacious hold when once seated. It begins with a cold, taken no one can tell how, perhaps: but the weak, dull, watery eye, and sluggish movement tell the close observer there is danger. If taken at this stage, and laxative feed is substituted for heating diet, the attack will likely pass off. If the pig is neglected a cough soon sets in, and in a few days it will be likely to snort in an attempt to clear his head, soon after rising from its bed. After this snorting has set in, the disease may be considered fairly seated. The progress of the disease varies largely, being influenced by the weather, feed, and care. Defluxion from the nose increases, and a cough becomes the habit, especially after being driven up out of its bed. The disease gains ground daily, and the pig sometimes rubs its head along on the ground, jerking it about as if in distress. After severe efforts to clear the head, blood comes from the nose, after which the pig seems to feel better for a few days. By this time it has commenced to lose flesh, its appetite is irregular, and often when it would eat it becomes so obstructed in its throat and head as to be unable to eat and breathe at the same time. After the pig has arrived at this condition, his strength diminishes. He cannot bear exertion; he will not thrive, no matter what care he may have. His strength gives way, and death ends the struggle. I think the course of a fatal cold that ends in consumption in human beings is a better diagnosis of the pig's ailment than I have given here.

I think this catarrh is generally fatal if left to follow its own course. It is certainly transmissible from either parent. I am fearful, too, that it is capable of propagating itself in the herd. In its latter stages it seems to be as infectious as glanders in horses. Of this I have not facts sufficient either to confirm my fears or to dissipate them. I want light. I think, however, the safe thing to do with a pig affected is to kill it on the spot, and burn the carcass. If I can keep my nerve up to my judgment, I shall try this method next year. I estimate that this disease has detracted 20 per cent. from the profits of my herd this year. I have lost three by death in a herd of 150. I think my herd is as healthy as any of my neighbors, or as swine generally. All my pigs are kept in herds of from six to twenty-five, and have airy, clean houses, new bedding every week, run on clover or blue-grass, have corn and slop made from mill-feed. I give salt, ashes, sulphur, and copperas weekly, and my swine have only pure spring-water to run to. They are never off the farm. Our soil is a black, bottom soil, with gravel subsoil, which breeders think not so favorable as clay land to health among swine.

Mr. T. J. CONOVER, Monroe, Butler county, says:

I have had considerable experience with diseases incident to hogs, and ever since cholera has been in our land I have been endeavoring to find a cure for it. I have tried many preventives and cures recommended by journals, &c., but found none of them to be certain remedies. For the last two or three years I have proven by my own experiments that the process of changing from field to orchard, meadow, woods-pasture, or roadside, or any new place will be attended with favorable results. At the first appearance of the disease I begin this changing process. I watch the hogs, and whenever they come back and lie around the place of entrance I give them a new place, and continue to do so through the day as often as I think necessary. I feed them no grain, but give them all the slops from the house. My theory is that the well ones will survey the new place, and the diseased ones will follow them around. This exercise induces a circulation and warms up the system. What grass and herbs they get will be found good for them. Now for the proof: In July, 1876, I had some ninety pigs, and out of this number saved seventy-five, which remained in good condition until proper age for market. One of my neighbors, who had one hundred and twenty head, saved but four. Two others, who had over one hundred each, saved but eight, and so on through a long list. My neighbors were trying different experiments with various kinds of medicines, while I was practicing the changing process. Thousands of dollars have been fruitlessly expended in the use of medicines, from which no benefit whatever was derived.

Last May my pigs were affected with cankered sore mouths and noses. Their mouths were so sore they could not nurse, and they were in an almost starving condition. I took them from their mothers, put them in a clean, dry pen, with good bedding, cleaned their sores, and applied grease to keep the scabs soft. I then fed them

on fresh milk with a little water in it, and they soon recovered. Pigs, if taken in time and treated in this manner, will generally recover. As to the cause of this disease, I have no knowledge.

Mr. Amos Todhunter, New Martinsburg, Fayette county, says:

The most prevalent disease in this locality is among hogs, and is called cholera. As it has not visited my farm, I asked the assistance of Dr. M. Todhunter, who is familiar with the disease, and he responds as follows:

The first sympton is that of fever of a typhoid form. Then follows a disturbance of the head, lungs, and bowels. When the lesion was on the brain sores would appear about the head, and the ears would ulcerate and emit a very offensive stench. When seated on the lungs there was an almost constant cough. When dead the lungs of some were found to be almost rotten, and smelled so bad that it was difficult to handle the carcass. In the absence of the above symptoms the animals seemed to live longest; that is, longer than when the lesion was on the bowels. The bowels ulcerate, and the ulcerated matter passes off with the fecal discharge. Constipation prevails in all cases. Those that are relieved earliest of this difficulty are the most apt to recover.

I tried all the remedies known, and they were very numerous, without much apparent good. The best treatment I found was to change frequently the locality of feeding, and to give them a good supply of salt and ashes, mixed with bran. This I fed whether the hogs were sick or well. I put the sick ones to themselves in a grass-lot, and fed lightly with slops, putting sufficient sulphate of magnesia into the slop to produce an operation on the bowels. I continued feeding lightly until there were signs of returning appetite, when I commenced gradually with corn.

I am of the opinion that over-feeding in the start is the cause of these diseases in swine.

As to my own experience I will say that I raise from fifty to one hundred head of hogs annually on my farm. It has been my practice to change their locality quite often during the course of the season, and to give them all the slops and soap-suds from the kitchen and wash-house. I also give them ashes and cinders from both coal and wood, adding salt, and occasionally a little sulphur, which I think has a tendency to destroy the lice which infest them during dry weather. I do not house them unless the weather is very inclement. They seem to thrive best when they have plenty of leaves to bed in. Next to this is corn-fodder, wheat and oat straw not being so good. With this treatment my hogs have remained healthy, while those of my neighbors have been attacked and died of the various diseases to which they are incident.

Mr. W. C. Hampton, Mount Victory, Hardin county, says:

The disease among hogs does not seem to be so fatal in our county as in many other places. From the result of investigations I should say the disease was intestinal fever, or perhaps consumption. The first symptom of the complaint is a bad cough and a refusal to take food, especially corn in the ear, which they will smell of and pass by. Perhaps their jaws are too weak to crack the grain, for they will eat it when ground into meal. They continue to lose flesh for a month or more, when they die. A few have so far recovered as to permit fattening. Upon examination, the livers and lungs of these animals are found greatly deranged, both being covered with white spots. Another peculiarity is that the intestines and stomach are very much reduced in size, which I think would indicate the effects of a high state of fever. No remedies have proved of any benefit. We have tried sulphur, tar, and copperas. Those saved were fed freely on corn-meal. This may have had a good effect in keeping up the strength of the animal until the disease abated or was worn-out.

Chicken-cholera has been severe in some sections of this county. In this locality it was more modified and slow, but finally sure in its operations. They would mope around for weeks before death ensued. The disease must be much the same as that which afflicts hogs, as the liver is found greatly enlarged and in a decaying condition.

Mr. C. Lewis, New Vienna, Highland county, says:

The hog is by nature a very healthy animal, and should be the same in his artificial or domestic state. Therefore, in investigating his present condition, reference should be had to his original habits and surroundings; and the nearer we can approach this in his domestic condition the better. We find that in his natural state his home is in the forest, where he can roam at will and indulge his appetite in partaking of its productions in the form of roots, grasses, herbs, fruits, berries, nuts, &c., in their proper season and natural purity; making his bed in leaves by the side of logs or other temporary shelter, changing the same at pleasure, and reconstructing his bed out of new material, and all the time using his "snoutish" proclivities to the full bent of his instinct. Thus we find him a healthy, and in his maturity a powerful animal. Now, the nearer we can conform to these first principles or habits of the animal the better, for

the preservation of health and prevention of disease is far better than all the remedies known or unknown. In his natural condition we find him comparatively free from all filth, dust, and foul air, making his bed out of leaves or grass on the ground, sleeping few in a bed, and drinking pure water. And now, as to his domestic condition, I will not say habits, for he is no longer free to exercise these; and right here is the first line of demarkation between health and disease, and must be so considered if we wish to arrive at the truth of the matter. The cause of the disease seems to be more easy to point out than to remove. In the first place, there are, as a general thing, too many hogs kept together in the same inclosure, which gives them an opportunity to "pile up" in their beds when the weather is cold and stormy, becoming not only overcrowded but overheated; thus laying the foundation for disease by disturbing their normal condition. By this confinement they are also compelled to a greater or less extent to be ever present with their waste matter, which at certain seasons is more detrimental than at others; hence at such times they are more liable to attack by the so-called epidemic diseases.

Another cause of derangement and disease is dust, which is generally most abundant at the season when the waste matter is most offensive and detrimental, thus producing a double aggravation of the cause of disease. Another productive cause is the habit of keeping the same stock of hogs on the farm for a number of years, even when there is an annual change of male hogs. If a change of pasture will make fat calves, an entire change of stock will certainly produce better and more healthy hogs, other things being equal.

Now as to the diseases to which the hog is subject: Though naturally healthy, they can secrete a mountain of disease, and it does seem that a diseased hog is the worst diseased animal on the face of the earth. There appears to be an epidemic disease of the lungs, commencing with a cough and followed by loss of appetite, general debility, and finally running into something similar to lung-fever, which is generally fatal. The principal producing and exciting causes of this disease appear to be dust, too many occupying the same bed, foul air, and exposure to cold, wet storms. (The disease seems more common among pigs and shoats.) There is also a disease of the bowels, which might be termed cholera or diarrhea, and seems to prevail more extensively among hogs fed on dry corn. I have never known a hog fed on soft or cooked corn to be afflicted with the disease. There in still another disease, that of the spine or hind legs, which appears to differ from the so-called "kidney-worm," and is not unlike rheumatism as it affects the human family. This is generally fatal. There are also diseases of the liver, intestinal worms, &c.

Mr. EVAN GOOD, of the same county, says:

Hog-cholera, so called, is and has been for three years alarmingly prevalent in this and adjoining counties. Last year the disease was terribly fatal, probably from 60 to 70 per cent. of those attacked dying. This year the fatality has not been nearly so great, simply for want of material, farmers in nearly every instance having sought and found a market on its first appearance in their herds. An exception should be made of those cases where the whole herd was attacked at or nearly at the same time.

You ask for a complete diagnosis of the disease. That would be a task to appal the stoutest. Probably no two men could give the same report. Scarcely two animals on the same farm are held in the same way. Pigs from six to ten months old die faster than those of twelve months and upward. Many more die after the fattening season commences in the fall than at any other time. Hogs having a wide range of woods pasture are less liable to infection and more likely to recover when attacked than those confined in pens or small lots, notwithstanding the danger of contamination would seem to be greater.

Here are a few of the symptoms as I have seen them and as they have been reported to me by neighbors: Fever in nearly all cases; a dry cough is often a premonitory symptom; vomiting; purging; bleeding at the nose; bleeding through the pores, particularly about the head; paralysis of the hinder parts; giving way of the fore legs; dropping off of the ears and tail; constipation. One man who saved eleven head out of one hundred and four this fall says that the lungs, or the portion next the heart, was always diseased, while a membrane which surrounds the heart was filled with water. Sometimes, while eating, a hog will give a squeal of agony, jump a foot or two from the ground, and fall dead. No cure has been found. Turpentine and capsicum are the only preventives I know of that are worthy the name. They will not always prevent, but they have the effect to brace the system for the attack. It is the opinion here that those who have seen the most of the disease know the least about it. Those who have not seen it have at least a theory. Those who have suffered by it come out of the siege with their theories crushed. It is the most confounding and bewildering disease that can be imagined; it will not be investigated. Let the department dig this thing up, and it will have the everlasting thanks of this plague-ridden section. But do not let the investigator enter the field with a theory, or he will be disgusted at the outset. Let him follow facts and base his theory thereon.

Mr. PETER HOLLOWAY, Monclova, Lucas county, says:

A very fatal disease has prevailed among hogs in this vicinity. Mr. H. L. Holloway, of Springfield, had ninety head attacked with it. It seemed to partake of the nature of a lung disease, as it was attended with coughing and a high fever. The teeth also appeared to be tender and sore, as the animals could not bite corn off the cob. Those that died were almost completely covered with sores. The cause or origin of the disease is unknown. One theory is that they contracted the disease by lying and wallowing in the mud and water from the overflow of an artesian well strongly impregnated with sulphur. The disease was first observed September 1; its greatest fatality occurred October 10, and the last death on December 20. Of the ninety head attacked, two were shot, three recovered, and all the rest died. The skin on those that recovered nearly all pealed off. They were in good condition up to the time of attack, having run in blue-grass and clover pasture during July, August, and September. Those that were afflicted were carefully cared for. The remedies used were arsenic, calomel, charcoal, sulphur, copperas, fresh meat, and carbolic acid, but without any beneficial effect. The age of these hogs ranged from four weeks to five years.

The disease is regarded as contagious, for the following reason: About the time of the commencement of the disease, but before he was aware of its existence, Mr. Holloway sold a sow and five pigs to a Mr. Graham. They were taken to a distant neighborhood and put into a pen with another pig. Soon after they were taken sick and died, as also did the pig which was confined with them. In an adjoining pen were six fattening hogs. One of these was taken sick, and in order to prevent the further spread of the disease Mr. Graham killed the balance.

Mr. G. W. RAUDABAUGH, Celina, Mercer county, says:

The only disease from which serious losses have been sustained is from cholera among hogs and chickens. The disease has prevailed quite extensively among hogs the past season, and on some farms it is still prevalent. Two years since it prevailed in a mild form, and about 20 per cent. of those attacked died. This season it was more extensive and fatal, and the losses were about 50 per cent. of those affected.

We thought we had a remedy for the disease, and in many instances it seemed to check it at once; but the past season it failed to bring the expected relief. The prescription for fifty hogs is as follows: Two pounds black antimony, seven pounds copperas, five pounds sulphur, and two pounds saltpeter. Two years ago my neighbor gave this remedy to his hogs after he had lost twenty-five out of a herd of seventy-five, and he lost no more. Notwithstanding the same remedy was given to about one hundred hogs this season, about one-half of them died. Two years since my hogs were attacked by the disease. I gave them no remedy, but removed them about three-fourths of a mile from their old haunts into a woods pasture, and they all recovered. This season they were attacked in October, and out of fifty head about thirty died.

The disease is always more fatal among pigs than among older hogs. The symptoms are not always the same. In the first stages food is taken very reluctantly and does not seem to be relished. Indisposition to move and general stupor follows; a cough sets in, which I think is caused by a nauseated stomach, and a great disposition is manifested to lie on the belly. In a few hours after death, in almost every instance, the carcass becomes wonderfully swollen. All things considered, this is one of the most difficult diseases to understand that animals can be afflicted with. My hope is that your investigations may result in the discovery of at least a preventive, if not a permanent cure, for this terrible scourge.

Mr. DAVID B. BYERS, Miamisburg, Montgomery county, says:

The hog-fever has been very prevalent with us this season, nearly every farmer having suffered more or less. The first symptoms are dullness of the eyes, loss of appetite, and great thirst. The symptoms are not always the same, however. The duration of the disease is from twenty-four hours to two weeks. I used many remedies, but I am not able to say whether any of them did any good or not. I finally discarded all remedies, and fed only green corn. After this I lost none that were able to eat. Out of a herd of eighty-six I lost fifty head. One of my neighbors opened one, and in the throat he found thousands of small worms, so small, indeed, that they were scarcely perceptible to the naked eye. Others, who made like examinations, reported the lungs and liver in a greatly diseased condition.

PENNSYLVANIA.

Mr. L. N. OTT, Harrisburg, Dauphin county, says:

In some portions of our county hog-cholera makes its appearance almost every year. It does not seem to be confined to any particular locality. The prevalence of the disease is probably attributable to want of proper care and the kind and quality of the food given the animals.

Mr. M. DICKSON, McConnellsburg, Fulton county, says:

As regards hog-cholera, it first made its appearance in this county and this neighborhood one year ago last summer. This locality is called the "Big Cove," and is about twenty miles in length, running north and south, and about six miles in width. The disease does not spread rapidly. As near as I can ascertain, 25 per cent. of the hogs in this area have been afflicted with the cholera. (Remember, the disease has not visited any other portion of the county.) About 90 per cent. of those attacked died, a large proportion of those dying being young hogs. They are affected differently. With some the bowels are constipated, while in others looseness prevails. The former symptoms result more fatally than the latter. One uniform symptom or result of the disease is that it settles in the throat, and the animal dies from suffocation or starvation. No treatment, so far as I can learn, has resulted in any good, and the prevailing opinion seems to be that all remedies are worthless. If there is any preventive, it seems to be in the plentiful use of salt. My hogs escaped, while those on every farm around suffered. The disease has entirely abated within the last month, and I hear of no cases at all.

Mr. T. S. GILLILAND, Van Wert, Juniata county, says:

Hogs are suffering here from what is known as hog-cholera. They are mostly taken with a cough, and some die in a few hours, while others linger for three or four days, sometimes for a week or two. When opened the lungs seem to be very much affected and have a very offensive smell. Some persons claim that they can detect this smell while the hogs are yet alive. They seldom recover. Some apparently get well and gain in flesh, and then die. One man brought me a portion of the fatty part of a hog that he said had had the cholera and recovered, and had fattened as well as the rest of his hogs; but the meat was a bright yellow. I thought likely this discoloration was caused by an obstruction of the gall-duct, so that the gall had disseminated itself like in jaundice in persons.

The cholera seems to be epidemic in its nature, taking off nearly all the hogs in a neighborhood, while other neighborhoods may entirely escape. Changing hogs from one place to another seems to be beneficial. One man had his hogs in pens, and after losing between forty and fifty turned them in a woods lot, after which he lost no more. He thought he had discovered the cause. Another farmer had his in a large field, and after losing about thirty he put the remainder in pens, and they did well. He thought he had found the cause and a remedy. Some of our physicians claim that the disease is lung-fever, while others think the affection of the lungs is not the first cause.

TENNESSEE.

Mr. H. SHACKELFORD, Woodbury, Cannon county, says:

I have to remark that no disease of a fatal character exists among any of our farm animals except hogs. The disease generally known as hog-cholera has been prevailing in this county and other counties contiguous to it to an alarming extent, many of the farmers in the community having lost nearly their entire stock, so fatal has been its ravages in many localities.

As to a diagnosis of the disease, nothing definite or satisfactory has been arrived at so far as my investigation or information extends. The disease is developed in the same herd of hogs in various forms. For example: Some among the herd, apparently in good health, will be suddenly attacked with vomiting and purging, and will die in from twenty-four to thirty-six hours. With others the disease will assume a different form of attack. Some will make constant efforts to disgorge the contents of the stomach, which seems to be locked up in their bowels. This constipation continues with many of them from the time they first take the disease until they die. Many of them thus afflicted will live from one to two weeks, and I have known a few to wear out the disease and recover; but the few that survive rarely ever make thrifty hogs. I may further state that a great many hogs of different ages and sizes sicken and die without exhibiting the symptoms above pointed out. In a majority of cases which have come under my notice within the last two years, the disease can be easily detected in any herd of hogs by the symptoms indicated, apart from the vomiting, purging, &c. Whenever a farmer discovers among his hogs any that move around as though they were too lazy to get out of each other's way, afflicted with a squeaking cough, stiff in their joints, and when standing or walking hang their heads near the ground, with a most offensive effluvia exuding from their mouths and nostrils, accompanied by loss of appetite but insatiable thirst, also manifesting a strong desire to find a warm place in which to lie down, and, when lying down, lie on their bellies instead of on their sides, they should be at once separated from the well ones; or, perhaps, the owner would be no worse off in the end to kill all such to prevent others from taking the disease from them.

I am of opinion that it will be needless for me to write anything on the subject of preventives and cures, as all the remedies heretofore introduced and tried in this section of country have been pronounced a failure by the most of those who have tried them. I am well satisfied in my own mind that not one of the many remedies which have been introduced and vouched for can be relied on as a cure, from the fact that what is commonly termed hog-cholera I believe to be a variety of diseases, and it is just as absurd to suppose that one remedy will cure all the diseases of hogs as that one remedy will cure all the diseases of man. Nevertheless, of the many remedies which have been brought to public notice, I doubt not but much good has been done by at least preventing disease, if not in some abstract cases effecting a cure.

I am an old man, and a firm believer in that old trite maxim, "An ounce of preventive is worth a pound of cure." If, therefore, the Department of Agriculture can, by further investigating the subject, discover a remedy which will check up or effectually stop a disease whose ravages hitherto have not been confined to any locality or climate, it will confer a lasting benefit on our nation.

Dr. J. R. WOOLFOLK, Macon, Fayette county, says:

In answer to your inquiry, "What is the nature of the disease which now prevails among the hogs of your community?" I must say that from the very casual examination I made of one that died of the disease, I am not prepared to give a satisfactory diagnosis, and will only say that I found complete engorgement of the liver, with enlargement of the same. The lungs presented no indications of disease, nor did the intestines. There was a collection of serum or bloody water in the pericardium or investing membrane of the heart. There were no indications whatever of inflammatory action on any of the abdominal or thoracic viscera, except the liver. There was positive passive congestion of the capillary circulation generally, which I have reason to believe was not stasis anæmia, as might reasonably be supposed. It is the same disease which prevailed to such a destructive extent among the hogs in this country in the year 1868.

Mr. GEORGE W. WALKER, Springfield, Robertson county, says:

Messrs. Moore & Woodward, near this place, last spring bought two hundred and eighty hogs from the farmers in the surrounding neighborbood for the purpose of fattening at their distillery. The cholera broke out among them, and before the disease abated they lost two hundred and fifty, valued at $8 per head. The disease spread through the neighborhood, and also prevailed in some other localities. The opinion seems to be that the disease is contagious, and that if farmers would keep up their hogs, and not allow them to come in contact with those affected with the disease, its spread might be prevented. Mr. Wilson Pitt, who lives near this place, and within two miles of Moore & Woodward, raises annually five or six hundred head of hogs at his distillery. Last year, while the cholera was raging on every side of him, he fattened six-hundred head of his own raising without the loss of a hog by any disease. I am of the opinion that the disease called hog-cholera is the disease described in the books as "hog-measles."

TEXAS.

Mr. R. L. HIGHTOWER, Elysian Fields, Harrison county, says:

There is a disease which prevails here among hogs called cholera. I am satisfied it is the same character of disease as the so-called chicken-cholera, as it made its appearance about the same time and under the same conditions. Therefore, my remarks on the subject of the former will apply to the latter, with this exception: The disease among hogs has not been so general as that among fowls, nor does it always prevail among both classes at the same time. I had no such disease, nor any other, among hogs until last year, although I and my father before me have kept hogs on this place for forty years. Last summer I had a small herd of Berkshires running upon grass. In August I observed one to be sick—no appetite, great thirst, many eruptions on the skin as if full of small boils. He did not purge, but seemed constipated. He remained sick about a week, when he died. I gave him nothing. Another, a sow, took sick about the same time, with like symptoms. She died, and after death the hair came off the carcass very easily. She had no discharges from the bowels, that I observed. I gave her no remedies. A third hog, a barrow, was sick about the same time—looked emaciated and hollow; had copious discharges from the bowels all the time of his sickness, of a very loose, watery, greenish character. I gave him nothing except a little saltpeter dissolved in water. He never lost his appetite, and finally recovered. A fourth barrow was similarly affected; had copious, green, watery discharges, with many little eruptions on the skin. When exercised he would cough as if about to strangle with phlegm. He drank from the water-trough, in which I had dissolved some saltpeter and soft soap. I gave him nothing else, and he recovered. He was sick about fourteen days. A brood-sow was taken sick and lost her appetite. She was

apparently constipated, and had great fever. She would eat nothing, and seemed to have but little disposition to drink. She was apparently in great pain, and coughed as if greatly oppressed in the chest. I did not succeed in administering any remedy to her. She was sick only about twenty-four hours when she died. The next day my Berkshire boar was taken sick with copious discharges from the bowels. It had high fever and no appetite, and looked hollow. Its eyes were sunk in its head, and it had every appearance of a human suffering under a violent attack of diarrhea. I was alarmed, as he was my most valuable hog. I promptly administered about a teaspoonful of calomel in water. In about six hours I repeated the dose, giving him to drink in the interval a strong solution of soft soap in water. The soap was made with lye from wood ashes, with the addition of a one-pound box of concentrated lye to about twenty gallons of wood ashes and common soap-grease. In twenty-four hours he was well. I think the purging natural to the disease, and, when copious, is favorable to recovery, even when no remedy is administered. I am no physician, and have no particular knowledge of the science; therefore, my conjectures may be very crude and erroneous. But I think both hog and chicken cholera have their germ in a disordered liver, causing great prostration of the vital powers. And now to suggest, in a rough, off-hand way, the remedy, I should say calomel, and, where there is great prostration, such tonics as are used in practice upon human beings. As to a preventive, my mind has failed to reach any conclusion. With no more warning, and as suddenly as the angel of death came upon the hosts of Sennacherib, does this distemper seem to come upon our herds and flocks. On highlands and on lowlands, in winter and in summer, in the spring and in the fall, among flocks that have the master's care and among those that do not, in good weather and in bad weather, this death seems to have all times, places, and seasons for its own. Yet there must, from the very nature of things, be a preventive; so let us all unite to discover it.

Mr. C. B. RICHARDSON, Henderson, Rusk county, says:

Before the war I lived near the Mississippi River, in Carroll Parish, Louisiana. A disease called cholera broke out among the hogs. It was the first epidemic ever seen by the planters in that vicinity. Most of the planters had very large herds of hogs, as there was a good range in the swamps back of the farms. Every form of treatment was used, without any marked success. The attacks of the disease were quite sudden. Some would swell up and the flesh would look livid, and they would die in twenty-four hours. Some were constipated and others would have diarrhea. Fat hogs, as well as lean ones, were subject to attack. I had two killed when first taken, and got my family physician to assist me in making a *post-mortem* examination. The bowels were constipated, and the inflammation of the bowels and stomach was very great. I kept the hogs in a dry inclosure, under the gin-house and cotton-shed. I put tar in the troughs, and fed with corn boiled in lye and copperas water, and poke-root decoction to drink, and used various other nostrums in vogue without success. I burned the hogs that died. One neighbor drove his well hogs four miles into the swamp, and made a man camp with them there, with some success, he thought, as they appeared to die at a less rapid rate.

I have lost some large hogs and pigs this summer with this epidemic here. The disease appears to be a violent fever, and kills the animals in a very few days. I put one fine hog in a lot where it had a good, dry shelter. I tried to doctor it with liquids. but could not tempt it to drink anything. I tried to give it a dose of calomel on a piece of beef, but could not induce it to eat anything at all, and finally gave it up to die. It lay three or four days in its bed, and after awhile it got up and ate a few mouthfuls of corn, and finally recovered without any treatment. I fattened it this fall, and on butchering it I found the lungs and intestines adhering strongly to the sides, and the intestines also tied in lumps with fine ligaments. On the intestines was a large ball four inches in diameter, filled tight with thick matter like dough.

Many nostrums published as cures have been tried with such little success that the farmers now let the disease take its course without attempting to do much of anything. When a hog once refuses to eat, little can be done for him.

Mr. J. L. DEEN, Johnstonville, Upshur county, says:

A disease among hogs here is called red mange, which is always prevalent during summer. If not immediately treated the hogs will die. A successful remedy is composed of mercurial ointment, sulphur, oil of peppermint, lard, tallow, and carbolic acid, well mixed. The animals should be rubbed with this, or a good-sized ball should be taken, a stick run through it, and the stick driven in the ground near their feeding-troughs where they will rub against it.

Hog-cholera also prevails here. There is no remedy for the disease, and at least nine out of every ten attacked die. In the first stages of the disease the above remedy for mange is said to be about as good as anything else. The duration of the disease is very short as a general thing, although a few cases linger along for some time, shed off every hair and hoof, and finally recover; but they are not much account for a year or so afterward.

CORRESPONDENCE RELATING TO DISEASES OF CATTLE.

ARKANSAS.

Mr. H. S. Dodd, Doddsville, Marion county, says:

During a residence of six years in this county I have not known anything like an epidemic among farm animals or fowls in my neighborhood. In the county of Boone, adjoining this on the west, some cattle have recently died of what is called dry murrain, and many hogs have died of cholera. I examined one cow, and found the same symptoms present as observed in cases of Spanish or Texas fever in cases which I had examined seven years ago in the State of Kansas. I find on inquiry that Texas or Southern cattle have been driven through Boone county the past summer, and therefore believe the disease to be the same. The first symptom noticeable is a sluggish movement. In the second the ears and head droop, the eyes sink in the head, and the toes of the hind feet drag on the ground. The duration of the disease is from two to six days. On examination the urinary organs present a very large and inflamed condition. The stomach is discolored to a black or dark red, and the contents are very dry and hard. Some remedies have been administered, such as diuretics and very active cathartics, with considerable success. My opinion is that such treatment is wise, and will in almost every case effect a cure where the treatment is persevered in, and not delayed too long in the beginning. The diuretic used was nitrate of potash, and spirits of terebinthina the cathartic. Hog's lard was also used in large and frequent quantities.

IOWA.

Mr. Thomas D. Tyler, Ottumwa, Wapello county, says:

Until this fall cattle have been very healthy in this vicinity. A disease is now prevailing among them which is very destructive. It is called "black-leg." The Weekly Courier of this place says: "William Shepherd, living four miles north of this city, has within a very short time lost eleven head of fat cattle from a disease which seemed to baffle the skill of the most successful veterinary surgeons. Yesterday he lost another fine animal, and sent for Dr. Hinsey for the purpose of holding a *post-mortem* examination. The examination was held, and the doctor informs us that he found that the cattle had been dying of 'malignant anthrax,' or 'black-leg.' In the case he examined he found the cavities of the heart occupied by a clot of blood as black as ink, and nearly the size of his fist. The mass was firm and tough, and when removed the blood of the arteries, of the same consistency of that of the center of the heart, followed its removal in strings the full size of the arteries and several inches in length. The disease is very contagious from a dead carcass, or from the blood of the animal when tasted by other cattle. * * * The doctor gives it as his opinion that when stock is affected by this disease the farmer would, in the event the case proves fatal, do well to bury the carcass of the animal without even removing the hide. So far as is known there is no remedy for the disease, and the best thing to do is to prevent its spread. Two or three other farmers have recently lost cattle."

MASSACHUSETTS.

Mr. S. E. Stowe, Grafton, Worcester county, says:

Abortion in cows, here in the central part of Worcester county, is becoming quite an alarming disease. Since receiving your letter, by inquiry I find that about one-fourth of our cows lose their calves, some at four, but the majority at from six to eight months along, causing a loss to the farmers of one-half their value for dairy purposes.

There has been nothing done in this vicinity, or in the State, to find out the cause or discover a remedy. My own conclusion is, that the disease is caused by some weed that is eaten by the cows, both in grazing and in the cured hay.

Mr. John Brooks, same county, writes:

I last year raised fifteen Hereford steer calves. I bought twenty, and out of this number lost five by a disease called "blind staggers." I think eight or ten of them in all were affected; and I lost five before I discovered the nature of the disease and found a remedy. I do not know but there is a better remedy than the one I used. The calves, when first attacked, would not take nourishment, but held their heads up and walked around the pen until they were exhausted, and then, in about two or three days, would lie down and die. I lost five in that way. Four I saved in the following

manner: I turned new milk down them three times a day—two quarts at a dose. I mixed about one half pint of castor-oil with the first dose every other morning. I kept this up about six days, when they again commenced to take nourishment. They appeared weak for about eight days after they commenced improving. They lost flesh, but not to any great extent, and seemed to winter as well as those that had not been sick.

The calves were constipated, and I gave the oil to remove this difficulty. I can define no reason for this sickness. I have lost calves for a number of years in the same way, but now think, if taken in season, they can be cured by the above remedy.

MICHIGAN.

Mr. Harry Haynes, Coldwater, Branch county, says:

I think we lose more in value from the effects of milk fever, so-called, in our milch cows, than from losses from all other diseases. This disease usually attacks the cow within from four to twelve hours after she drops her calf. It generally proves fatal. I watch my cows closely at this critical time, and if they have no operation of the bowels for six hours I give them twenty drops of croton-oil with half a gill of sweet spirits of niter. This I give in one pint of warm water, and repeat in six hours. Since I commenced to use this as a preventive I have not lost a single cow, though I previously lost several each year.

MISSOURI.

Mr. George W. Parker, Vandalia, Audrain county, says:

There are but few fatal diseases among cattle here. Sometimes they die of a disease called black-leg. I know of no remedy, but salt given at regular intervals at all seasons of the year will be found a good preventive. I have handled many cattle at a time, and with very good success. In a herd on the grass beside mine twelve or fourteen head were lost while I lost none. I salted my herd regularly, while my neighbor failed to take this precaution. I salt twice a week, and have regular days for so doing.

Mr. A. J. Pruitt, Forsyth, Taney county, says:

There is a disease prevalent among our cattle in this county known as black-tongue, which is very fatal unless properly treated in its early stages. The only successful remedy known here is a preparation of copperas and salt, equal parts, and freely applied to the affected part (the tongue).

NEW YORK.

Mr. A. A. Holcombe, V. S., New York, writes as follows concerning contagious pleura-pneumonia:

This disease was first seen in Central Europe about a century ago, and since that time has spread to most European countries, to Great Britain, Asia, Australia, and America. Its spread was undoubtedly due to contagion, for it is not at all probable that the disease originated spontaneously outside of Central Europe. It is a specific disease peculiar to bovine animals, for other species are never affected with it. It is always subacute or chronic in character; usually occurs as an epizooty or enzooty, and spreads easily and rapidly.

As the term indicates, the *lungs* and the *pleura* are the seat of the disease. It is not considered an inflammatory disease, and so far as local lesions are concerned, consists in an exudation of lymph into the connective tissues of the lungs, with effusion and exudation into the pleural cavities. The disease may be limited to one lung or it may affect both, while occasionally the pericardium is implicated. One attack usually confers immunity from subsequent ones. During its course the disease generates a specific virus capable of inoculating healthy animals of the same species with the same disease. By some few authorities it is believed that the disease can be generated by improper dietetic measures in conjunction with certain other influences, as excessive milking, and hot, illy-ventilated stables, but there is no positive proof to support this belief, although it is to be noted that the outbreaks in New Jersey in 1873–'74 and in 1877 were almost exclusively confined to cattle fed on beer-grains, which were kept in close stables, and gave large quantities of milk. The disease was brought to this country in 1849, and has prevailed to a greater or less extent in different localities ever since.

The period of incubation is reckoned at from twelve to sixty days, and the symptoms

during this time are, as a rule, so slight as to receive little or no attention from owners or attendants. A rise of the bodily temperature is the first indication of the disease, and can be detected with the thermometer alone. Healthy animals have a temperature of 100° F., or a little less, so that a rise above this in an infected district would render all animals so affected liable to suspicion, for in those where the thermometer registers 102° F. or more the disease can almost positively be said to exist. The first symptom to gain the attention is mostly a short, dry, husky cough, of a peculiar character, and is first heard in the early morning, or while the animal is drinking. At the same time the appetite will be observed to fall off a little, and rumination be less active than common. The respirations are more rapid than normal, and may reach twenty, twenty-five, or thirty per minute, instead of about fourteen. Usually every respiration is accompanied with a low grunt or slight moan. The cough is growing more frequent, harsh, and painful; the back is slightly arched; the coat looks dead, and feels rough and harsh, while in some places it is erect; pressure along the back, especially in the neighborhood of the loins and in the spaces between the ribs, causes pain and flinching. As the appetite falls off the secretion of milk diminishes, until it is finally completely suppressed. The patient generally rapidly runs down in flesh, the surface temperature varies, the extremities being cold at one time and hot at another; sometimes but not always a slight discharge takes place from the nostrils, and the pulse becomes quite rapid. The lungs at this time are undergoing changes, easily detected by the expert; the air-cells admit but a limited quantity of air to the affected part; the intestinal tissue is filling up with lymph, and the pleura is undergoing the changes seen in this disease, presenting symptoms to be detected only by the practiced ear, as loss of the respiratory murmur, the presence of the different râles and the friction murmur of pleurisy, with finally the absence of any sound at all as the lungs become hepatized in the second stage, or the one of *marked* symptoms. In this stage the temperature increases and the pulse runs up to sixty or seventy, and sometimes to ninety, beats per minute. Examination of the heart will show it to be laboring hard to send the blood to the diseased lungs in sufficient quantity for the system; the extremities are cold; the front legs apart to facilitate respiration, which is becoming more and more rapid and difficult; the appetite is entirely lost; the secretion of milk has ceased; the feces are hard and dark-colored; the urine is scanty and high-colored; drinking causes hard and painful coughing. The animal almost refuses to move, seldom lies down, and stands with distended nostrils, moaning at every respiration, while from the eyes and nose is discharged a thickish, purulent fluid, and the breath is hot and fetid. These symptoms daily grow worse as the disease encroaches on the previously healthy lung-tissue; breathing is effected with the greatest difficulty; the pulse is so weak and small as hardly to be felt; the skin clings to the bones; dropsy beneath the chest takes place; the animal becomes almost unconscious of all surroundings, and groans and grinds the teeth; the abdomen fills with gas; diarrhea sets in, and death speedily closes the scene.

This is the usual course of a typical case where the disease runs through both stages and terminates fatally. In many instances there are variations from this general course, as where a fatal diarrhea sets in early, or some other complication occurs which carries the patient off. (An interesting complication occurred in a case at North Branch, N. J., in 1874, where the lungs filled up rapidly and the pulmonary artery was ruptured.) But these variations are important only to the student of special pathology.

Regarding the course and termination of this disease, it is to be noted that it runs a more rapid course in young, vigorous animals than in any others; also that a short period of incubation is almost always followed by a rapid subsequent course. At times the disease terminates favorably in the early stage and before the extensive alterations of the lungs have taken place, yet these organs rarely regain their perfect function, part of their tissue ever after remaining impervious to air, while adhesions more or less extensive permanently exist between the lungs and the walls of the chest. The cough usually remains for a long period of time, being due to the alteration of lung-tissues. Death, as a rule, takes place in the second stage of the disease, and is due to the encroachment of the exudate upon the respiratory surface of the lungs, to anæmia, to gangrene of the lung-substance, or to a fatal diarrhea.

The percentage of deaths which occur in the early part of an outbreak generally reaches from 60 to 90 per cent. of those infected, while later on, when the force of the infecting virus seems to have expended itself, the mortality may fall to 15 or 20 per cent. But this is not all the loss to which the infected district is subjected. The animals that recover are of little or no value for weeks and months, the secretion of milk does not return for a long time, and it is almost impossible to prepare them for market, for they do not thrive. Besides this, unless the subject of disinfection is understood, and its necessity thoroughly appreciated, all new animals are liable to take the disease and thus perpetuate indefinitely this dreadful scourge.

The intimate pathological anatomy of this disease, and the microscopical appearances of the involved tissue, can hardly be of value to the public, or to others than those thoroughly acquainted with histology, so that unless the department desires especially

to have such I will refrain from occupying your time with what can hardly prove of interest. I will therefore call your attention to the means of diagnosing this disease. The cough is peculiar, and to those acquainted with the disease would be almost sufficient evidence of the presence of the contagious form of pleura-pneumonia. The thermometer is of the utmost value in detecting the disease early. A physical examination of the chest, the temperature, character of pulse and cough, will always be sufficient to diagnosticate the presence of pleura-pneumonia. That it is contagious will be seen by the incubative stage, by the insidiousness of its course, and from the fact that it has no connection whatever with the causes which produce the ordinary form of this disease, that is, with climate, exposure, change of weather, food, &c. Also from the fact that it spreads by contact, and is very fatal. Lastly, some animals are not susceptible to the disease, about 15 per cent. escaping infection even when subjected to the influence of the contagion. The infecting principle of this disease is no doubt both fixed and volatile, for it is found in the blood, excretions, secretions, exudated lymph, and in the expired airs. The vitality of the virus is great, lasting sometimes for several months. It may be carried by the air a distance of at least three hundred feet, while by means of diseased meat, affected clothing, hay, straw, cars, and steamboats it may be carried to long distances.

Mr. J. E. KARR, Big Flats, Chemung county, says:

About the 1st of October last I bought a lot of cattle in the Buffalo cattle-market, said to have been raised and fed in the State of Wisconsin, and on the 10th of the same month nine of those cattle were sick and one had died. I sent for Professor Law, veterinary surgeon of Cornell University, and after examination he said they had the Texas fever. I commenced using his prescription to prevent the disease from spreading and to save the sick ones. Out of nine attacked I lost five head. On the 19th of November I bought another car-load of cattle, said to have been raised in the States of Ohio and Michigan. About two days ago the same disease made its appearance among them, and how many of them I shall lose time will tell. Now, what I wish to say unto you is this, as you are at the head of the Department of Agriculture you might lay such facts as these before Congress, and ask it to enact some law to prevent the spread of the disease by prohibiting the transportation of Texas cattle to the East. These cattle are brought to the markets of Chicago, Detroit, Buffalo, and indeed all the great cattle-markets of the country, where they are fed and watered, and the next day cattle from other States, or native cattle, as they are called, are brought in, and, eating the hay the Texans left, get the disease and spread it all over the country. No one is responsible. Farmers who go to the markets to buy cattle are not to blame, as they do not know what yards sick Texans have been in, and dealers do not care as long as they can sell and get their commissions. I do hope you will try to get Congress to do something toward prohibiting the shipping of diseased Texas cattle through the country.

Mr. FRED. P. NEWKIRK, Oxford, Chenango county, says:

In reply to your inquiries, I would say that abortion in cows and blackleg in calves are the principal diseases in this vicinity. Not keeping cows, I can give you little or no information in regard to abortion. Keeping about one hundred calves, I think I am well posted in regard to blackleg. A calf attacked with it will be stiff in the limbs, its eyes will sink in the head, and it will lose its appetite. The duration of the attack is from two to twenty-four hours. Sometimes they will live two days. I have never heard of one recovering. After the discovery of an attack of blackleg the animal is as good as dead. If bled, no blood will flow. The disease usually settles in the legs, hips, or shoulders. The exact locality can be ascertained by rapping on the animal with the ends of the fingers, and when the affected parts are reached the sound will be like that produced by rapping on blubber, and, in fact, when cut open the part affected will be found black and blubbery. I have cut a slit four inches long in a shoulder without a sign of distress, the part affected being entirely dead.

In those that I have dissected the internal organs were found perfect, but the heart and veins were full of coagulated blood as black as tar. The fact that little or no blood can be drawn from the large vein in the neck of the calf attacked is to me conclusive evidence that the disease is one of the blood.

I think bleeding is a preventive; at any rate, I lost three with the disease in as many consecutive days, and I immediately bled the balance in the neck, taking about a quart of blood from each, and have not lost a calf since. A neighbor of mine, keeping twenty-three calves, lost six during the fall months with the disease. He bled the balance and lost no more. The calves are usually attacked after being turned on "after-feed," and should be bled before, and again in October.

Mr. CYRUS RICE, Sardinia, Erie county, says:

Occasionally during the past twenty years we have lost a few cattle by a disease which I think is diphtheria. Many have, no doubt, died for a lack of a knowledge of

the disease, and others because remedies were not applied soon enough. The first symptoms are profuse weeping, quick and labored breathing, driveling, and, as the disease advances, the pulse quickens. In the last stages of the disease the blood courses through the veins like a running stream. The animal refuses to either eat or drink, its flanks settle in, and it wanders around until it finally falls down and dies. After losing six head by the disease, the writer saved several others by a free use of whisky, giving saltpeter and borax in the first stages. The last-named articles (a tablespoonful of each) can be given in a bran-mash once in every two or three hours, if the animal does not refuse to eat. If it refuses to take food, the throat should be well swabbed. When the disease extends up the pharynx and into the cavities of the head, and a thick, yellow matter runs from the nostrils, it is questionable if the disease can be reached so as to effect a cure. A few years since a neighbor of mine cured a cow of the disease by feeding saltpeter and borax in the inside of potatoes, which she would eat. A year thereafter the cow had a second attack, which failed to yield to treatment, and she died. I do not doubt that any medicine that is efficacious in diphtheria in a person would be good in this disease in stock, providing it was used in time. Perhaps a free use of sulphur might prove beneficial.

There is another disease that, so far as I know, has always proved fatal, although of not very frequent occurrence. It usually attacks calves, yearlings, or two-year-olds. The first symptom noticed is seen in the animal lying down, a refusal to eat, and, in a short time, inability to get upon its feet. It generally dies within from twenty-four to forty-eight hours. On taking off the hide, the legs and body, on one side, appear as if bruised to a jelly. I think the jelly appearance is the result of inflammation, but the cause is unknown here. It is sometimes called murrain, but I doubt if that is the correct name of the disease. We have no remedy.

Mr. J. D. Smith, Greig, Lewis county, says:

A disease made its appearance among cattle in this county in July, 1877, where it still exists. It attacks old and young. The first symptoms are manifested by stiffness and great pain, as the animal moans continually and so loud that it may be heard some distance, loses its appetite and cud, and has no action of the bowels; manure, if any, is as black as ink; if a fresh cow, the milk dries up entirely within three hours, and the animal almost invariably dies within forty-eight hours. On opening the animal blood is found in bunches in the veins, the flesh is bloodshotten on the stomach, and inflammation of the bowels is revealed. No very close examination has been made here. Various remedies have been tried, and I have succeeded in curing one of my own cows that was attacked by the disease. I gave her one pound of Glauber salts dissolved in warm water, and every hour for six hours gave her a quart of strong boneset tea, rubbed her bod yand joints with a woolen rag to start the circulation of the blood, and in a week after the attack she was able to raise her cud, but gave no milk for two weeks. At the end of three weeks she appeared as well as ever, and is all right now. This disease prevails on sandy soil, where the feed is good and the water is pure. It is new to us, and is alarming. No cattle have been attacked with it since they were taken from the pasture and shut up.

Mr. Martin J. Sackett, Houseville, Lewis county, says:

Thiis is a dairy county, and there is no prevalent disease exeept among cows. We have lost heavily from garget in the udder of cows. Poke-root sometimes helps it. but not often. Lumps very frequently come also in the teats of cows—a sort of stoppage—which has been a source of great loss to us. We know of no remedy.

We have suffered also from abortion among cows to the extent, in some instances, of hoc-half the herd. It has not been so prevalent, however, the past three years as it was previous to that time.

Mr. J. M. Anable, Naples, Ontario county, says:

We have been very much annoyed by abortion in cows. It seems liable to come on at any time. No cause has been discovered, and of all the remedies that have been tried none have proved of the least benefit. When it gets into a herd it generally affects from one-third to one-half.

There have been a few cases of blackleg among calves, that were in good condition. About all of the cases proved fatal. No preventives or remedies have been found.

Garget or udder-ill has been the source of much annoyance with our best cows. The disease affects the udder and causes the milk to become lumpy; if the disease is severe it becomes bloody, the teats swell, and hard bunches appear on the udder. As a remedy one quart of warm lard and one-half pint of molasses given as a physic. together with frequent bathings of the bag with cold water, and drawing off the milk three or four times a day, will be found beneficial. If inflammation should be great apply fomentation to soften the udder, and use a mild liniment or ointment. About 20 per cent. of our cows are affected by this disease, anp about 10 per cent. of these are rendred unfit for dairy purposes.

Mr. FRANK D. CURTIS, Charlton, Saratoga county, says:

Any section of country in which cattle-yards and feeding-stations connected with lines of transportation are located is liable to be infected with such contagious diseases as may exist among the cattle transported or collected at the yards, or which may be superinduced by the conditions on the cars and at the yards favorable for their development. Thus at the Central Railroad station and sale-yards located at East Albany, N. Y., contagious diseases have been disseminated, and this must continue to be the case in the future. Great precautions should therefore be inaugurated by the adoption of sanitary laws, looking to the prevention of such danger, by making provisions to regulate and control all animals which may come to these places, or which may develop contagious diseases after their arrival. Under no circumstances should the proprietors of such yards be permitted to allow diseased animals, or those supposed to be infected, to leave their yards. A stringent prohibitory law of this character should be passed by Congress to prevent the spread of contagion, which might entail losses of millions of dollars. We have some infectious diseases among the domestic animals of this country which are liable to spread any year with disastrous results, hence the necessity for the immediate enactment of such a law. Congress has wisely laid an embargo upon the importation of cattle from foreign ports or places where contagious diseases exist, and a precautionary measure regulating the transportation and exchange of animals in this country is almost equally important and necessary, especially in connection with the great transcontinental and shipping routes.

Murrain.—The oldest cattle disease of which mention is made, either in sacred or profane history, and which in malignant form has broken out and destroyed many cattle in various countries from the most remote historical periods, has not as yet prevailed in the malignant forms of olden times in our favored land; in fact, we do not know that any such disease has existed here. Forms of fever of a malarial character and other types have, in different localities, been called murrain, but they have seldom spread beyond the herd or locality where the disease existed. A change of locality, bringing with it the change of climate and diet, have usually resulted in a cure, particularly where the disease was of a malarial character. Its prevalence, therefore, is generally due to local causes, such as bad air, bad food, and bad water, coupled with filth and exposure. Murrain has probably been used by writers in all ages as a general term for all malignant fevers and disorders which have been especially fatal in their character or contagious in their nature. In America, as elsewhere, the term has sometimes been used to designate fatal disorders among cattle which were really specific diseases, requiring special treatment, as they were of distinct and separate character. Malignant types of fever and diseases of the kidneys, lungs, and stomach have all been classed as murrain. Each of these cases of so-called murrain would, therefore, require different treatment, and the same general rules of proper care and management should apply to all of them, and act as partial, if not effectual, preventives to each.

Pleuro-pneumonia.—This infectious and contagious disease was introduced into this country in May, 1859, by an importation of cattle from Holland by Chenery, of Massachusetts. Two of the cattle were sick when they arrived, and died a few days afterward. The disease proved to be the virulent pleuro-pneumonia, and from this herd it spread far and wide. No kind of treatment availed anything with animals affected with the disorder at that time. So fatal and destructive was the malady that in April following an act was passed by the legislature of Massachusetts providing for its extirpation, and authority was given to a commission appointed for the purpose to kill all cattle which had been exposed to it. The disease raged with more or less fatality, notwithstanding these precautionary measures, until the year 1865, when it was apparently eradicated. More than a thousand cattle were killed and buried in this State alone to prevent its spread. The State paid out, in compensation for the cattle killed by direction of the commission and for other expenses connected with the extirpation of the plague, $67,511.08.

As this and other cattle-plagues were raging all this time in Europe with disastrous results, Congress was induced to pass a law prohibiting the importation of cattle into this country from any district in Europe where any contagious disease was prevailing, and we believe all cattle are quarantined long enough before embarking to determine whether or not they are infected. This precautionary embargo is most important, and should be continued without repeal or modification. A milder type of pleuro-pneumonia appeared in the vicinity of Albany and New York, but not being as virulent as the disease which was spread from Mr. Chenery's herd, it was eradicated by treatment and isolation of the animals and herds affected. In the eastern part of New Jersey and near Baltimore, Md., it prevailed for several years, causing considerable losses, but we believe it has disappeared. In the first stages laxatives of castor-oil or raw linseed-oil should be given, and blisters applied to the surface over the lungs, on each side of the chest. As the disease progresses, tonics may be administered. The animal should be kept carefully housed and free from exposure, and as widely separated from other cattle as possible. Filthy stables was one of the causes which helped to develop this disease, if not the only cause, in the vicinity of Baltimore, and no doubt

too close confinement, together with foul stables and the constant breathing of vitiated air, caused it to break out among the dairy-cattle of New Jersey. Swill-milk establishments would be the natural source of this malady, and they should be watched with great care, as one animal from such a pest-house would spread contagion far and wide.

Epizootic apthar, or foot and mouth disease.—Following closely after pleuro-pneumonia came the epizootic apthar, which, however, was of a milder type and generally yielded to treatment, although convalescence was sometimes slow and tedious. The disease was communicated by a virus or contagion thrown off from the points of eruption in the mouth, teats, or feet, where the disorder generally manifested itself outwardly by blisters or pustules. It was strictly a contagious disease, but absolute contact with the virus was necessary to impregnate a fresh animal. Isolation, therefore, was very effectual in helping to get rid of it, and in preventing its spread. It had been known in Europe since 1695, but did not reach Great Britain till 1839, when it came with some Dutch cattle. It will be remembered that pleuro-pneumonia also came to America from Holland. The foot and mouth disease was first observed in America in 1870, and during the autumn and early winter of that year it prevailed to a small extent in Oneida county, New York, and quite extensively in Dutchess county, in the same State. It undoubtedly was spread from the stock-yards in Albany, where the virus was left by cattle brought from Canada. From Albany it was carried by cattle to the cattle-markets at Brighton, Mass., near Boston, from whence, as a matter of course, it was scattered to other points where the cattle were taken. Mild laxatives to aid in eliminating the virus from the system were given, and tonics if there was a tendency in any animal to sink. The pustules and the surface of the body should be kept clean. No better disinfectant could be used than carbolic acid diluted so as not to irritate the raw flesh, and this wash is also exceedingly curative. Absolute quarantine is necessary to keep the disease from spreading. All manure and straw should be plowed under, and so should all rags or anything else used about infected animals. No one should wash the sores who has any abrasion of the skin or sores which might be infected. For several years we have heard nothing of this disease, and we safely conclude it has been expelled from our midst. As we understand its nature and symptoms much better than we did when it was a stranger to us, if it ever should visit us again we will doubtless meet it at the threshold and prevent its extension.

Constipated fever.—During the prevalence of a severe drought in the summer of 1877 a fever broke out among cattle on the plains near Schenectady, N. Y., which was exceedingly fatal to all animals attacked. It was confined to one neighborhood. Ordinary physics did not seem to mitigate or ease any case. The progress of the disease was very rapid. This section of the country was suffering with the worst drought known for years, and the grass of the pastures was dried up. Water was very scarce, and all animals suffered for want of it. The exceeding dryness of the forage, together with a lack of water, undoubtedly caused this fatal disease, as it passed away as soon as the rains came and replenished the springs and caused the grasses to again become succulent. It might have been prevented if green fodder or a plentiful supply of roots had been mixed with the sunburnt and dried up grasses of the fields.

Splenic fever, or Texas cattle disease.—This disease has created so much alarm through the country, and especially along the great avenues of transportation and centers of the cattle trade, that a description of its nature and progress, as well as the treatment of the malady, is deemed important. The disease, so little known in Northern States until within a short period, can be traced back to the eighteenth century, and has existed ever since. It should not be called "Texas cattle disease," as it is not peculiar to Texas, but obtains this sobriquet from the fact that nearly all cattle driven northward come from Texas or the Indian Territory. In August, 1796, a disease was communicated by a drove of South Carolina cattle to cattle in Eastern Pennsylvania, and to all cattle coming in contact with them, or occupying the same yard after them. None of the Southern cattle died. Nearly all of the infected natives, however, did die, but failed to communicate the infection to others. Before that day, and from that day to this, splenic fever has been communicated by cattle from malarious Southern districts to those of higher northern latitudes. Northern cattle are infected by crossing the tracks of those from the South, or by being yarded or pastured in the same inclosure. The disease resists medical treatment, and almost invariably proves fatal. The virus cannot pass through a second generation and infect in turn still other animals. Not an instance is known of such a result, though a single case is said to have occurred in New York State, in which the virus must have been received directly from a Texan, and not from a sick or dead native. The name splenic fever was given by Professor Gamgee, because the spleen was found to be the organ mostly affected, as it was invariably found greatly enlarged. Of several hundred spleens examined in one week, in August, 1868, those of native cattle average 1.39; of Cherokees, 2.36; of Texans, 2.79. An instance of one weighing eight pounds is reported. Immediately after the close of the war the pent-up and accumulated herds of cattle in Texas sought an outlet through Missouri and Kansas, and left disease and death in their track. The cattle-raisers on

the borders finally combined for protection, and with guns in hand confronted and turned back the invading herds. Again, in 1868, they came up the Mississippi in boats, landed at Cairo, and were dispersed through Southern and Central Illinois, were shipped eastward in cattle trains, and spread alarm and consternation from Illinois to Massachusetts.

The losses were heavy, amounting to about fifteen thousand head of cattle, and aggregating about a half million of dollars. The entire loss that year was undoubtedly larger than this, and may have reached a million of dollars. Prompt repressive measures confined the disease to few localities. In Champagne county, Illinois, a heavy cattle district, the loss was five thousand cattle, the heaviest, perhaps, during that visitation. The heaviest loss known before the war was estimated at two hundred thousand dollars, and occurred in Vernon county, Missouri, in the year 1858. The following are marked characteristics of this disease: It is communicated only by Southern cattle. These cattle are apparently well and increasing in vigor, but on *post-mortem* examination exhibit spleenic enlargement and other signs of once-existing disease. Infection is only communicated in summer. Frost destroys it; time also eliminates it from the Texans. Sick natives cannot communicate the virus to others; even their sucking calves do not take it. The infection appears to be communicated through voided excrements. Its incubation period is not of uniform length, varying from one week to a month, or even six weeks. In a few cases a longer time has elapsed—three months in one instance. It runs its course in three or four days, sometimes in one or two, and is fatal in nine cases out of ten. Medication has proved of little benefit, though there is some color of probability that skillful treatment and careful feeding with soft mashes have been of some benefit. It is not a malignant typhus, and has no analogy among human diseases. Neither is it analogous to the fatal Rinderpest of the East. It is not epizootic, but is deemed by Professor Gamgee to be enzootic, due no doubt to local influences capable of limited spread and analogous to red or black water, a disease more common in Europe than in America, and which is often traced to the influence of marshy grounds and malaria. The organs showing the greatest signs of injury are the fourth stomach, the liver, gall-bladder, spleen, and kidneys. The pulse is frequent and temperature high; the skin is dry and rigid, feces occasionally flecked with blood, head depressed, back arched, muscles trembling and not under control. As there are no remedies which can stay the progress of this disorder, it is evident that immunity from its fatal effects lies in prevention, and this can only be brought about by the most assiduous care and arbitrary regulations restricting the passage of diseased cattle through the country and requiring their quarantine as soon as evidences of infection are apparent. As this disease is liable to be brought into our midst by Texas cattle any summer, on their way to the tide-water markets, the imperative necessity of quarantine stations and obligatory laws enforcing the same are living issues for consideration at all times.

Puerperal or milk fever.—Cows in a plethoric condition at the time of calving are very likely to have puerperal or milk fever. This danger is very much increased in proportion as there is a large natural distention of the milk-veins and udder, which is usually the case with heavy milkers. The disease is often sudden in its results, but may be prevented oftentimes by milking the cow some days before calving, and by administering gentle laxatives. Soft bran mashes would be good but for the fact that they would tend, by furnishing more nutriment, to promote the secretion of milk, thereby increasing the inflammation and fever. Great care must be exercised in giving medicines before calving, and there is no better treatment than the simple remedies mentioned. After calving, where there is evidence of a fever, it is best to continue the lexatives, and to wrap the animal in woolen blankets and pour slightly cool water around the body, putting on wraps enough to produce a thorough sweating, and consequent evaporation, which will generally produce relief. The sweating should continue for several hours, according to the severity of the case. After sweating the animal should be thoroughly rubbed and covered with dry blankets, and kept in a warm stable. Injections of tepid water should be given to soften the feces, which it will have the effect of cooling, and also of cleansing the intestines and bowels. Injections of this kind will do no injury, and if repeated often will have a soothing and curative effect. Cows which are poor and weak at the time of calving are inclined to have a slow, debilitating fever. All such animals should be kept in a warm place, and fed strengthening and stimulating food. In case of severe prostration, an ounce of whisky may be given every two hours until there is an appearance of renewned strength. It would be far better, however, to have given the strengthening foods previously, so that the animal would be in a vigorous condition before passing through an ordeal so depleting and enervating in its effects upon the physical system. Animals should be put in condition as much to bear their young as for slaughtering, and it is much cheaper to do so than to take the risks of having the young in an enfeebled condition, which is always a great detriment not only to the mother but to the unfortunate offspring.

Garget, or swelled udder.—This disease is closely allied to puerperal fever, and is one that is almost universal among dairy cows. Generally it yields to simple treatment,

such as rubbing or kneading the bag. This may be very much aided by allowing the calf to brunt it, which it will do if the milk is withdrawn before it is turned in to the cow. This method of breaking up the cake in the cow's bag and of reducing the swelling generally results in making the cow's teats sore, as the calf bites and chews them in efforts to extract milk. They will heal rapidly when smeared with oil or grease, if the calf is kept away from the mother. With young cows, whose teats are more tender than older ones, letting the calf suck is a bad practice, as it makes the young mothers untractable and hard to milk. The best treatment for swollen udders is to inclose the bag in a tight sack and steam it with water as hot as the cow will bear it, then rub it thoroughly, and afterward apply a wash of alcohol and camphor, and an ointment. If the bag does not yield to this treatment, we would recommend a more thorough sweating of the whole body with flannel blankets, which will help to eliminate the fever and inflammation from the udder. If the local inflammation shall continue obstinate, with coagulated milk or bloody secretions, then a quart of the decoction of the roots of poke-weed (*Phytolacca decondea*) may be given daily in a warm mash of bran. This will aid to redress the inflammation in the glands. Injections should also be given and laxative food, such as roots and bran. There should be no exposure during this delicate period with the cow, and all chills should be avoided, either by exposure to storms, cold drafts, or cold feet or water.

Abortion.—This disorder has prevailed to considerable extent in most of the dairy sections of the State of New York, but with more violence in the counties of Herkimer and Oneida, where it has been very destructive for a number of years past, causing a great loss to the dairymen of these two counties. It has extended, also, with disastrous frequency to the counties bordering on these. No treatment or precautions seemed for a time to avail anything. A little over ten years ago the disease was at its height, but for the last four years it has greatly diminished.

No special cause was ever discovered, as the reasons which might account for its existence in one locality would not account for its prevalence in another, where the surrounding circumstances were entirly different. A commission was appointed by the State of New York to make extended and minute investigations, but they did not discover a satisfactory cause, nor did they recommend any effective remedies. It assumed the form of an epidemic and swept away thousands of cattle. Probably the careless and exposed manner in caring for dairy cows, and the depleting and enervating draughts made upon them by long milking periods, and the sympathy which exists among diseased animals, helped to stimulate this disorder and to bring it out in its full degree of violence and fatality. In individual cases it is generally easy to trace the cause, which may be a strain, slipping on the ice, by being hooked, or by a too sudden and abrupt change of feed, such as from dry hay and meal to grass, and a discontinuance of hay before the stomach becomes accustomed to this relaxing and more succulent form of food. Medical treatment to prevent abortion cannot be prescribed, because usually the trouble culminates before there is a knowledge that it is coming, and after the symptoms are discernible it cannot be stopped. When the symptoms are apparent, soothing ana laxative medicines may be given to allay fever, and if in cold weather the animal should be warmly covered and kept so, and given only warm food and drink. An aborting cow should be removed from the rest of the herd as soon as discovered, as her trouble produces excitement and causes a sympathetic influence or shock to the other cows, which may produce a similar trouble with them. If weakness and prostration follow the culmination of the disorder, an ounce of whisky may be given three times daily as a tonic, until the natural strength returns. This should be coupled with plenty of oatmeal gruel and bran-mashes, with good hay.

Blackleg.—When cattle, and especially young calves, have been fed nothing but dry food all winter the blood becomes impure, and all of the tissues of the body more or less impaired or stagnant in their action. A sudden change to succulent feed sets all of their organs into more vigorous action, and there is an effort on the part of nature to eliminate from the system all the impurities which have collected during the winter. The stimulus is too great to force them out immediately by the usual process of evacuation and evaporation, and consequently the inflammation which they may cause may settle in one set of organs, or in some particular spot which may have been exposed to the cold ground, or some point where there exists a constitutional weakness. Hence we will have a local inflammation, which may be on the leg, or it may become seated in the kidneys, when it is known as red or black water. If in the leg it is known as blackleg, which does not yield readily to any form of treatment. As soon as lameness is discovered, and this is the first symptom, a seton should be put into the most fleshy part and active fomentations applied. For calves mild cathartics, say four ounces of Epsom salts, should be given daily, with double the dose for full-grown animals until they are better.

Red and black water.—Under the head of blackleg we pointed out the main causes for these disorders. Bleeding would reduce the amount of blood and help to relieve the kidneys from a work they are unable to perform. An active perspiration produced by covering the animal with blankets and pouring on water, or, if a small beast, by

putting it in a tub of hot water as little below the boiling point as possible, will help to relieve the kidneys and open the pores of the skin, and thereby induce a lively evaporation. After sweating, give sweet spirits of niter and powdered sulphur, from an ounce upward, according to the size of the animal. If the above simple treatment does not effect a cure, a purgative dose of castor-oil, from two to five ounces, and from three to six ounces of Glauber salts, according to the size of the animal, may be given. Where there is inability to urinate on account of inflammation, give freely of mucilaginous drinks (flaxseed tea or slippery-elm bark), with one ounce of spirits of niter until there is relief. Cloths wrung out of boiling-hot water and laid across the loins will aid in getting the kidneys at work, and will help to reduce the inflammation. If cattle are fed plenty of salt and sulphur for a month before being turned out in the spring, it will help to purify the blood and open the pores of the skin. When sulphur is fed to stock it will not be safe to expose them to cold storms, as they are then much more susceptible to colds. Salt and sulphur are also good remedies for preventing blackleg and kindred diseases.

Diarrhea.—This is the most common disorder among farm animals, and usually proceeds from indigestion. It may be and is often excited by colds. Young animals raised by hand are very often afflicted with it, and sometimes, though rarely, a mother's milk, when drawn by the offspring, will produce this disease. This only occurs when the milk is too rich in butter and on this account is not well digested. When this is the case the young animal should be given milk from another beast, or fed on extract of rennet or pepsin, which will aid in the healthful digestion of the richer milk. The simpler remedies should always be tried first, especially in treating young animals; hence in mild cases of diarrhea a few drops of laudanum may be given, or a small quantity of ginger tea, or a pint of scalded milk. It would be well to give one of these remedies with a tablespoonful of extract of rennet, and if there is no cure then use other medicines; purge the stomach with salts or castor-oil, and follow this by astringents, such as alum, &c., graduated according to the size of the animal and the severity of the case. Scores of cows have been treated in the above manner with favorable results.

Dysentery.—Diarrhea, if not suppressed, will run into dysentery. This disease may also be caused by straining the bowels, or by sudden changes of the weather, which produce colds and consequent inflammation. It is a disease of the bowels, while diarrhea is a disorder of the stomach. It requires prompt treatment. Castor-oil is the best purgative, to be followed by soothing doses of arrow-root and milk gruel. The disorder must not be checked too suddenly, or the fever, which always accompanies it, will be increased, as will also the danger. If the disease continues after thorough purging, give from a half drachm to a drachm of tincture of opium. The disease may be known by the griping pains which accompany it and the offensive smell of the excrement, which is often coated with the mucus which lines the inside of the bowels. Lying on the cold and frozen ground is one of the most potent causes of this painful and weakening disease. It sometimes becomes chronic and will not yield to any form of treatment. A valuable Ayrshire bull, ten years old, was taken with diarrhea in the autumn. It was caused by overfeeding with corn-meal. He was getting three quarts a day, and the man feeding him being directed to double the quantity, making six quarts a day, understood the order to be six quarts twice a day, making twelve quarts in all. In less than two weeks diarrhea set in, which rapidly ran into dysentery of the most violent type. Cathartics, followed by powerful astringents, were given, but no cure was affected. As soon as the owner discovered that the animal was sick the meal was discontinued and he was allowed to eat nothing but dry hay, and this diet, together with the astringents, served to check the purging; but it did not altogether cease. Further treatment was relinquished with the hope that in the spring, when turned out to grass, nature might correct the disorder. This, however, was not the case, and he continued to grow weaker and weaker. The scours did not cease until late in the fall, when he was in such an emaciated condition that he was killed. During the winter and summer his excrement showed that his food was not digested, and the stench arising from his feces was unendurable. Had the condition of this bull been observed in time—before the functions of digestion were completely broken down—he possibly might have been cured.

In another case a young cow was taken with dysentery, also caused by overfeeding. In this case the disease was checked, but the digestive organs were left in such a feeble condition that she never could digest more food than barely sufficient to keep her alive, and it was found impossible to fatten her. She was in a better condition on grass than on dry food, but although allowed to run barren a whole summer to grass she did not gain in flesh, and the following winter, though fed with great care, she did not thrive, and was finally killed as a worthless animal.

Another cow, two weeks after calving, took cold from exposure in the barn-yard, which brought on a severe dysentery. Laudanum was administered without any benefit, and in three days the cow died.

No general rule in regard to the quantity of concentrated food to be given to animals

can be made. It ought always to be fed to them by persons of judgment and experience, as there is great difference in the digestive abilities of different animals; then, again, there is so much difference in the character of the different kinds of food as regards the readiness with which they may be digested, and in their direct effects upon the system by heating or cooling, relaxation, or astringency, that great care and discrimination are necessary. It is proper always as a first principle, and an important one, too, in feeding meal of any kind, to graduate the mess according to the size of the animal, and not according to the age, as there may be great difference in the comparative weight of animals of the same age. Taking the meal of corn ground in the ear as the standard (this being the great staple food of America), one pint for every hundred pounds of live weight will be a safe average. This quantity may be increased if the animal evinces a strong appetite and hearty digestive organs. If coarser food, such as wheat or rye bran, be mixed with the corn-meal, the quantity may be increased without danger of injuring the digestion and, perhaps, with beneficial results. If roots in small quantity should be added, then there is less danger and more benefit to be derived. Too much concentrated food given at a time will not promote health or fatten an animal as fat as to divide the mess into two rations and feed morning and evening, for when there is more food poured into the stomach of an animal than can be digested or assimilated, it goes to waste. This also weakens the digestive apparatus. To avoid danger of diarrhea or dysentery there should be small beginnings in the feeding of concentrated food, as animals will never impair themselves by eating good and wholesome hay or straw if they are allowed plenty of water and exercise; but if they are confined and not allowed the necessary auxiliaries to health and digestion, the amount of fodder should be regulated and proportioned according to their size and weight. In the spring the change from dry food to green should always be gradual. This can be arranged by herding the stock at night, or returning them to the stable, where they may be fed some dry food, which they will generally eat with avidity. If this idea is faithfully carried out, one of the potent causes of abortion (blackleg, red-water, and dysentery) may be avoided. Sleeping in a warm stable, or, at all events, on dry ground, when first turned out, will help to keep stock free from the disorders mentioned above.

Colic.—All ruminating animals have more than one stomach. The cow has four, and they are so complicated as to make derangement frequent and the particular character of the disorder difficult to distinguish. If a cow or ox is sick in the fourth stomach, where digestion of the food is completed and where indigestion would work its most fatal results, it is exceedingly difficult to reach the case by any medical treatment, and it is equally if not more difficult if the disorder is located farther along and situated in the bowels. Indigestion, however, may begin in the first stomach or paunch. When this is the case it can readily be reached by medicines, but no medicines can complete the work of mastication, which the cow alone must do, and without which the contents of this stomach are unsuited to pass into the others; and if they do without sufficient maceration, a general derangement must necessarily follow. An aged cow, in good condition, which she had acquired on grass, was shut up at the beginning of winter to be fed for a beef. She fed heartily for a short time and then refused to eat. Soon after she evinced great pain and appeared bloated. A strong dose of ginger tea was given, but without relief. Bicarbonate of soda dissolved was afterward administered, which seemed to reduce the bloat. She was still, however, in distress, and would not eat. Injections of soap-suds, molasses, and water were administered without the desired effect. Several doses of physic were then poured down, one after another, with no effect, and the cow died. An autopsy showed that all the stomachs were packed with dry, partly mascerated and undigested food. All the food given to this cow had been dry. Her teeth were worn out, and imperfect mastication, together with the dryness of her food, had produced indigestion and colic, which, under the circumstances, could not be relieved or remedied by medicines. Colic, like dysentery, is always attended with gripes in the stomach; but a little observation will enable any person to note the difference. Flatulent colic will be spoken of under the head of "Hoven," but colic produced by constipation requires different treatment. Thorough purgative medicines and injections must be administered. Eight fluid ounces of raw linseed-oil, with four drachms of bicarbonate of soda, or three drachms of common saleratus, may be given to a full-grown animal, or, in place of this, one pound of Epsom salts. If these remedies do not have the desired effect within from two to six hours, double the dose of linseed-oil, or of salts, as the case may be. After purging an alterative of tincture of opium or laudanum, with mucilaginous drinks, should be given to sooth the stomach and bowels, and restore them to natural action.

Bloat or hoven.—This trouble is liable to occur whenever cattle with empty stomachs are turned into green clover or other rank green feed when the dew is on or when it is wet. As soon as the paunch or receiving stomach is overloaded with green feed, fermentation takes place, and the gas which is created causes its extension to such proportions that, unless it is speedily drawn off or neutralized, the organ may burst or the animal suffocate by the pressure on the abdomen and lungs. As soon as the dis-

tension begins the animal is thrown into great pain, which increases as the rumen enlarges. From an ounce to two ounces of soda or saleratus, dissolved in water and poured down the throat, will generally neutralize the gases and afford immediate relief. In case no remedies of this kind may be at hand or prove effectual, an incision may be made with an awl or penknife in the upper and most prominent part of the paunch, and a quill inserted, through which the gas will escape. If the flow of gas is interrupted, a wire may be run through the quill to remove the obstructions. The incision must be sewed up afterward, and care taken that none of the contents of the stomach come out and fall between the paunch and skin, in which case they may get into the cavity of the stomach and bowels and produce a dangerous inflammation. A dose of Epsom or Glauber salts (a half pound) should be given to aid in removing the corrupted and decaying food, which has been superinduced by fermentation. Cattle should never be turned into fresh pastures on wet days nor when the dew is on. The middle of the day is the proper time to make these changes.

Choking.—Many cattle are lost by attempting to swallow whole apples or potatoes, which lodge in the esophagus or gullet. Unless relieved immediately the animal will die, as the pressure of the obstacle upon the trachea or windpipe will cut off the air and the animal will strangle. The quickest and safest remedy, if the obstruction is within reach, is to place a large clevice in the jaws of the animal and have some person with a small hand thrust it down the gullet and pull it out. We have done this with perfect success. Sometimes the obstacle is beyond the reach of a person's arm, but can be plainly felt. In this case one end of the scantling should be firmly held against it on one side and the end of another short piece placed against the obstruction, when, with a smart rap, the obstruction may be mashed. Care should be had not to bruise the windpipe. Sometimes the obstruction will be lodged at the very mouth of the gullet, and it must then be reached by a probe run down the gullet. The probe should have a knob on the end of it, made either of wood or rags, and tightly fastened so it will not puncture the pipe or produce fatal injury. Coolness and promptness, with one or the other of the aids mentioned, will generally prove successful. It is much safer to crush or cut all roots in a root-machine than to risk feeding them whole, especially if they are globular in form. The choking is caused by the pressure of the obstacle on the trachea or windpipe, thus shutting off the air.

Wounds and cuts.—Wounds and cuts should receive the same general treatment as burns. The best kind of a wash is diluted carbolic acid, and when they are slight an application of coal-oil from gas-works will be found excellent, as it is an antiseptic, and in summer will keep vermin from pestering the wound and filling it with worms. Carbolic acid slightly diluted, one drop to five of water, will destroy proud-flesh, excessive granulation, and most effectually cleanse wounds which are putrified. A wash as strong as the above should not be used except in bad cases, but for all ordinary wounds the acid should be diluted to one drop to ten or twenty of water, according to the degree of putrescence. Currier's oil is probably the most healing in its effects, and, being offensive to flies, will tend to keep them away from the sores. It should be applied after washing and cleansing with the carbolic solution.

Inflammation of the lungs.—This complaint is more likely to affect working oxen, or cattle which have been heated by driving and left to stand in the cold in an exposed condition. It seldom affects cattle under other circumstances, unless they are taken from a warm stable and put into the fields and required to sleep on the cold ground, or are exposed to chilling storms. The symptoms may be known by hard breathing and loss of appetite. Bleeding from two to six quarts, according to the size of the animal, in order to relieve the lungs, should promptly follow the indication of the disease. The sides of the chest should be thoroughly rubbed with turpentine to produce an active counter-irritation. Laxatives should be administered with soft bran mashes. If in cold weather, the animal should be blanketed and kept warm.

Roaring.—Cattle often breathe hard when there is no inflammation of the lungs. In such case the difficulty in breathing is sudden and acute. The hard breathing, or roaring, is gradual in its development, and may proceed from diseased lungs following an old inflammation, or from a tumor in the trachea, or the gullet pressing upon it. It may also be the result of a bruise or an abscess in the chest, caused by a hook or contusion. We have known instances of roaring in cattle and sheep which proceeded from all of the above causes. There is no cure, and the best thing to be done on the appearance of the disease is to fatten and slaughter the beast before the growth of the abscesses and the development of the tumors on the lungs render the flesh unfit for food.

Kidney disorders.—These disorders are generally the result of colds or of constipation. Whenever there is a failure to urinate, from any cause, there should be active fomentations of hot water on the back in front of the hips. About an ounce of sweet spirits of niter should also be administered, with a strong laxative tea of comfrey root or flaxseed. The hot-water applications should be kept up for hours, in some cases, and a sheep-skin or buffalo-robe be bound on afterward to prevent a chill.

Inverted womb.—This is a common and severe trouble with cows. In some cows it is

a constitutional weakness, and in others it is the result of a strain or hook by other cattle. We have known the entire womb, with the calf in it, cast out inverted, with no possible way to get the calf out except to cut a hole into the womb. In a number of instances this has been done, both with sheep and cows, and the young saved alive, but in every case it resulted in the death of the mother. It is possible with a cow, when an inverted womb first presents itself, to gently push it back, and to insert the hand and turn it around so that the mouth shall open toward the outside and the presentation be made natural. Owing to the straining of the cow, it is a difficult undertaking, and in all cases the effort must be carefully and gently made, or an increased inflammation will be caused, which may result fatally. If the cow can be kept from breathing for a few seconds at a time by stopping the nostrils, she will not strain, and the effort to return the uterus will not be counteracted by her. In case of protraction of the parts before the time for parturition arrives, the exposed parts may be washed with milk in which a little tannin or the extract of white-oak or hemlock bark has been added, after which they should be gently pressed back and kept from falling out by bandages, which may be folded around the body and attached to a girth, or by stitches in the vulva, taking care not to stop the urine. If the placenta does not appear immediately after the birth of the calf, laxative drinks of boiled flaxseed and scalded wheat-bran mashes should be given. All attempts to tear it away by thrusting in the hand and loosening it should be avoided. Such operations are more than likely to produce fatal hemorrhage or inflammation. An injection of warm water in the uterus will be found beneficial.

Losing the cud.—When cattle are constipated and suffering from colic and fever, they will not chew the cud, or, in other words, they do not bring back the contents of the rumen to be remasticated, as they do when well. Usually when the cause of the ailment is removed they will begin to chew their cuds. Sometimes, however, when debilitated, they seem to lose the ability or desire to do so, and their food is therefore poured on into the other stomach without perfect mastication. Tonics should be given in such cases. The dry skin of a salted codfish is a good appetizer, and will often lead to the raising of the cud. The skin of pork or ham is also good.

Lice.—These parasites are common on cattle, and very injurious. They may be destroyed by washing the animal with carbolic soap or a decoction of tobacco. Mercurial ointments will kill lice, but they will also kill cattle when used by unskilled persons. Any kind of grease thoroughly mixed with salt will also destroy these vermin. Several applications should be made in order to kill those which may not be hatched when the first smearing takes place.

Mange.—This disorder is characterized by a roughness and soreness of the skin and a loss of hair, and is caused by a parasite which preys under the cuticle. A decoction of tobacco well rubbed in on the spots where the mange is apparent will cure it. A wash of carbolic acid, one drop in five, will also remove the difficulty. Always apply some sort of oil afterward. The decoction of tobacco should not be too strong, or it may poison the skin and produce eruptive sores. Mercurial ointment should never be used. Mange first makes its appearance in small spots, generally about the mouth and eyes. Unless eradicated the parasites will rapidly multiply and spread over the whole body. This disease is akin to scab in sheep. Cattle in poor condition are more liable to be infected; sulphur is the best internal remedy, but is rarely necessary except in cases which have been neglected until the whole circulating system has become infected, in which case a tablespoonful may be fed daily with good effect.

Malarial poisons.—Cattle are often poisoned by wading into creeks and sloughs and standing in the mud, which adheres to their legs and causes the skin to crack, often producing cankerous sores or ulcers. The virus from these ulcers will communicate disease to other cattle, such as foul foot, and instep foot-rot. It is the same principle which creates fevers among people in malarious districts. There is no better curative application for all irritations in this form than a wash of carbolic acid, in proportion of one drop to ten of water. This should be applied several times during the day, and be followed by some sort of oil or hog's lard.

Horn ail and tail-soak.—When a farmer or cow-doctor does not know what is the matter with a sick bovine, it is speedily denominated "horn ail" or "tail-soak." If, in their judgment, it is the former, then the horns must be bored and some vile thing be poured into the ears, or some irritating compound applied to the top of the head. These torturing and cruel performances set the poor beast wild, and in her pain she evinces an apparent improvement, which only confirms the torturers in the wisdom of their acts. If the horns are not cold it is regarded as tail-soak, whatever that is, and the tail must be split and salt and red pepper inserted and bound in, in order "to stimulate the body and purify the blood." Whenever any horned animal is weak and debilitated, either from lack of nourishing food or from sickness, the horns will be cold. Good food and tonics will bring them up to a more vigorous condition, and with it a better circulation and warm horns. Whenever they are in good condition the tail is soft and flexible, and if there is any derangement of the stomach or a fever, which may take them off from their feed for a time, the tail will remain the same, and no amount

of mutilation or doctoring of this appendage will cure indigestion or reduce a fever. The smarting of the raw flesh may cause the animal, which before was dumpish, to step around more lively, but this silly malpractice will cure nothing. Cleanliness is a virtue to which cattle are almost totally unused. The card and the brush are not known in many cow-stables, and so the poor brutes, confined most of the time by their heads, are compelled to live month after month with the dirt and scurf daily accumulating on their bodies and in their hair, until the pores are so effectually closed up that it is a wonder more of them are not stricken with fever. The outward secretory organs are rendered almost useless, and so much work is required of the internal organs that derangements and inflammations must follow. A freer use of sponge and water, and of the curry-comb and brush, would add very much to the comfort and health of these farm-animals, and add to their thrift and profit.

NEW JERSEY.

Mr. J. E. HANCOCK, Columbus, Burlington county, says:

I have had some experience with pleuro-pneumonia in cattle, having lost one-third of my herd from its ravages in 1861, when I succeeded in eradicating the disease after a duration of about six months. I had a second visitation of the malady in my herd in the early part of 1876, when I lost six head from a herd of twenty-three. My experience is that it runs its course in not over three weeks after the animal becomes so much affected as to prevent its eating—usually in a shorter time. Of the animals affected, I am satisfied not more than one-third will recover. I applied to a veterinary surgeon, who prescribed a powder which I think was a benefit, giving it, as I did, to the whole herd as soon as it was ascertained the disease was present. After the disease is fully developed in an animal I have very little faith in medicines, as a large proportion will die with the best treatment. Although my whole herd was not really sick, the larger part of it showed signs of the disease; some only for a few days, however. It remained among my cattle for about four months. I am of the opinion that on both occasions the disease was introduced by cattle purchased by me. The first case showed itself in about six weeks after the introduction into my herd of the infected animal; in the second case it was at least four months. I regard this as the worst feature of the disease—it remains dormant in the system of the animal for so long a time before it is imparted to others.

During the past few years this terrible disease has caused great loss to farmers in this section of the State. Many have had to contend with it, and numbers have suffered heavier losses than I have.

OHIO.

Mr. ORLANDO WILCOX, Hinckley, Medina county, says:

Some time last summer Mr. Whipp, of this county, went to East Saint Louis and bought ninety head of what are called Cherokee cattle, but their long horns, long legs, and gaunt bodies indicated plainly that they were of Texas origin. He brought them to Berea by rail, drove them home, and put them onto what is known as the Wilson farm. Some time in the early part of September his native cattle began to die, and kept dying until he lost about thirty head. I ought to have said before that these Cherokee cattle were very unruly, and went almost anywhere they desired. They jumped into most of the neighboring farms, but were driven out as soon as discovered. Among other farms they trespassed upon was that of Lewis Conant, where they were not discovered until they had lain down to rest. Soon after three of Mr. Conant's cows sickened and died. Upon close investigation it was discovered that these Cherokee cattle were infested with wood-ticks, which it was supposed they brought with them, as ticks are scarce in this country. The theory of the farmers in this township is that the Cherokee cattle communicated the ticks to the native stock. Our native cattle, not being used to them, had their blood poisoned, while the others, being used to them all their lives, were not affected. People going from a healthy country into a malarious district will have the fever and ague, and other billious complaints, while the natives who have always lived in that locality are but seldom attacked.

The cause of the Texas fever was much discussed in our local papers. Many contended that it was caused by saliva left on the grass by the Texas cattle; others that it was caused exclusively by the ticks brought by these cattle. It is certain that Whipp's cattle were badly infested with ticks, as a large number were collected and sent to the editor of the Medina Gazette. This was also indicated by the remedies used, linseed and kerosene oil. Where this was used in season a cure was effected. This Texas fever is the only disease that I know of that has been epidemic among cattle here. Sporadic cases of various diseases have appeared now and then, but we are pretty well versed in such diseases, and know what remedies to use.

PENNSYLVANIA.

J. BRICE, V. S., Erie, Erie county, gives the following diagnosis of a fatal cattle-disease which recently prevailed in that locality:

In reply to your inquiry respecting the cattle-disease which prevailed here for a short time, I would say that, so far as we know at the present time, it has completely subsided. Nearly all of the animals attacked died of the disease in length of time varying from a few hours to not exceeding five days. In some cases so rapid was the disease that animals thought to be in perfect health in the evening were found dead in the morning. (These sudden deaths were known only by hearsay.) The animals attacked, so far as known, were all milch-cows, and the only ones that recovered were young cows. Although some few others recovered, it is believed they were not suffering from the specific disease, but some disease consequent on overfeeding, and in some cases from lung-disease. There may be a cause for all the animals attacked being milch-cows, as the disease was confined to the city altogether, and few other cattle are kept in the city. In a barn in which was the greatest fatality there was a bull which stood through it all, his companions dying to the number of seventeen. Only two cows were left, one of which did not have the disease. The other, a young cow, recovered from a slight attack.

The disease was certainly splenic fever, charbon, or anthrax. The symptoms were extreme restlessness, loss of appetite, but not complete; thirstiness; feces natural at first but frequently diarrhea afterward; the urine profuse, and during the latter part of the disease dark red or bloody looking. The animal gave evidence of intense internal pain by her arched back, hanging head, and, if at liberty, by her constant moving, or, if tied, by pushing her nose into a corner and breathing laboriously. Although at first the animal had perfect control of her limbs, they became first weak, then staggering, and finally lost their power completely. She would then fall down, and, after a few ineffectual attempts to rise, would lie helplessly moaning until death relieved her suffering.

As to treatment, everything that was tried availed nothing. The fever steadily progressed to the end. Further research would seem to be something most devoutly to be wished for, and we hope that some measure of success may attend every attempt to find a cause and a cure for so fatal a malady.

All the cases in this section have been in that particular portion of the city where the cattle pasture over a large common, in direct communication with the railroad and cattle-yards, and where a number of Texan cattle were grazing after removal from the cars during the period of the recent railroad strike. Soon after that time the first cases were noticed; but the cool weather early in the fall appeared to check the disease, only, however, to break out with greater virulence during the hot weather in the latter part of September.

MORRIS CROHN, V. S., Erie, Erie county, says:

Since my residence here I have not observed any epidemic proper, though the splenic fever has been raging quite violently among the cows for the past month or so. Thus far it has been only local; and it is very extraordinary that, in view of the lamentable lack in this country of proper provision against the spreading of disease, the splenic fever has confined itself to one locality.

Splenic fever is due to the decomposition of blood; and, as the spleen contains a greater percentage of blood than any other organ of the body, it is most severely affected, and is totally destroyed if the disease be not arrested. Besides this, the kidneys, and sometimes the bladder, will suffer from sympathetic affection, a bilious condition being indicated by the eye. I think that splenic fever has its origin in one locality, caused by dry pasturage, stagnant water, filthy stables, miasmatic air, and gaseous exhalations of the earth; and its spreading is due to the disease-matter in the air, and gaseous exhalations of the earth. In every contagious disease there is a vital process; therefore, all the properties of such a process are requisite for the existence of the disease. In order that the process of disease in an individual may develop, there is necessary the union of a predisposition (the inner element of disease) and an infection (the outer element). The predisposition, as the basis capable of development, is analogous to the conceiving function in the female, and the infection corresponds to the fecundating function in the male. As all disease is dependent upon the destruction of the healthy process, so the principle of disease in splenic fever is due to the unhealthy, abnormal condition of the blood, causing the decomposition of the latter and speedy death.

I think it incontrovertible that the decomposition of blood in splenetic fever may be accounted for by an insufficiency of iron in the blood. Proof of this is that in many cases coming under my personal observation, where a timely treatment with preparations of iron, together with tonics in emulsions, was pursued, the diseased animals were saved. One ounce of muriatic acid and fifty ounces of water adminis-

tered once every hour, and after the fourth dose from one to three drams of quinine, is a very successful remedy. (Quinine, however, is too expensive for this purpose; *cortex chinæ*, from one to two ounces to the dose, may be substituted.) In addition to this, ice-water applications about the head and horns are of great benefit.

The disease appeared under three forms, with symptoms as follows:

1. Eye dull and inflamed; lack of appetite; feces thinner than usual, and slightly reddish; urine natural; pulse low; pulsation of heart increased. When the disease takes a fatal turn, chills and tremors appear; head and horns become hot; feces and urine bloody; pulse slow and at times suspended; beating of the heart perceptible; the eye assumes a dirty yellow appearance; horns grow cold and death takes place. Duration of sickness, six, forty-eight, and ninety-six hours.

2. Eye assumes a dirty red; pulse slow, suspending at times; beating of heart perceptible; urine bloody; feces similar to rice-water, offensive odor; head and horns hot. Duration of sickness from four to twelve hours. In this form of the disease a compound of one dram of opium and two drams of quinine has proven very beneficial.

3. I also noticed other varieties of splenic fever, which, however, were attended by no dangerous symptoms. Calamus and gentian, combined with tannin, makes a very good remedy.

There is a preventive to splenic fever used in Germany with good results, consisting of *natri sulphurici puto* 540 grains (*libram unam et dimidiam*), *sulphuris depurati puto*, 180 grains (*unc. sex*). This is given in tablespoonfuls with the food.

Mr. J. P. Tyler, Smithport, McKean county, says:

The most prevalent and fatal disease to which any class of farm-stock is subject here is blackleg among cattle. It rages only among dry stock and calves, or yearlings. When I came to this locality in 1870 I was told that the young cattle were dying off at a rapid rate with a disease that no one seemed to understand. I afterward discovered that this fatal disease was blackleg. With the exception of the past season, it has prevailed every year since. It seems to be more prevalent and fatal during the hot season of the year. I have never known a case to recover. The disease comes on suddenly, and generally terminates in death within from twelve to twenty-four hours. The symptoms are a swelling of some part or parts of the body, stiffness of the limbs, and sometimes short and quick breathing. A blubber appears under the skin of the part swollen, and the flesh becomes black, hence the name given the disease. The best preventive known is bleeding in the neck. Feeding of saltpeter with provender is also said to be a preventive, but is not so sure as bleeding.

Mr. William Zimmerman, James X-Roads, Somerset county, says:

We are sometimes troubled with a disease known here as "blackleg" among our cattle. In most cases the animal indicates great pain, and generally dies within a few hours. If the skin be removed after death mortified spots are frequently found. I once arrested the disease, after losing half my herd, by daubing their feeding-trough with pitch-tar, and feeding rosin mixed with saltpeter and sulphur.

Mr. Benjamin M. Hall, South Eaton, Wyoming county, says:

What is called "hollow-horn" among cattle is frequent here. The remedies are to slit the tails, bore the horns, and pour peppery, irritating fluids into the ears. When this is done the animal generally recovers.

A few winters ago a disease raged among our cattle for which we had no name. They lost the use of their limbs, and would swing their heads back and forth as if in great pain and distress. They died within from six to twelve hours from the time they were taken sick. I lost five head, and I believe every animal that was attacked died. We were foddering corn-stalks at the time, and the corn-fodder that year contained an unusual quantity of smut.

TEXAS.

Mr. S. J. Connor, Albany, Shackelford county, says:

The only domestic animals attacked by disease in this and adjoining counties, so far as I can learn, are range-cattle; that is, cattle which subsist on the range. The disease is called "blackleg." It manifests itself in the shoulder, neck, breast, or side. Few animals survive. The duration of the disease is generally not over twenty-four hours. The cattle usually attacked are one and two year olds, and principally of the improved breeds; that is, high grade or half-breed Durhams. The hair slips from the hide soon after death, and upon examination (one examination only was made) there was found a whitish mucous secretion in the windpipe. Not less than two hundred head of cattle died of the disease in this county last fall and during the present winter, and they still continue to die. No remedy seems to be known.

Mr. H. P. JORDAN, Victoria, Victoria county, says:

Native cattle are free from disease and comparatively healthy, but I think fully one-third and perhaps one-half of all the Durham cattle imported into this section of the State have died during the past two years from what people are pleased to term acclimating fever. The disease appears to be similar to that which afflicts the cattle in Missouri and Kansas, and which is supposed to be imparted to them by the native cattle of this State. I think all cattle brought here have this disease sooner or later. The first symptoms of the disease are fever and constipated bowels. The principal remedy used is castor-oil. The disease is a very serious drawback to the cattle-raisers of this State, who are trying to improve their long-horned Spanish breed with short-horns. If anything can be done to arrest it, great benefit will result to the people of this State. One of my neighbors lost four out of six fine Durham bulls, another lost three out of five, and a few have lost all.

CORRESPONDENCE RELATING TO DISEASES OF HORSES.

FLORIDA.

Mr. M. A. KNIGHT, Middleburg, Clay county, says:

For many years past a disease called staggers has prevailed among horses in this locality. It is a disease of the brain, and in my opinion is brought on by overwork, or in permitting the animal to graze during the heat of the day. The symptoms are an entire loss of appetite, costiveness, restlessness, a disposition to walk and seemingly not caring where, and oftentimes describing a circle. As a remedy, bleeding freely in the hind parts is practiced with considerable success. I prefer to cut off the end of the tail, and if necessary cut off a second time if the first operation does not give a free and continual flow of blood. Then bathe or rather pour cold water on the head until the disease is arrested. This should be followed by a good dose of Epsom salts, say one-fourth of a pound dissolved in water, and repeat if a free movement of the bowels does not follow the first dose.

In the early recollection of the writer, say twenty-five or thirty years ago, this disease was very fatal to horses, probably not more than one in twenty being saved by treatment then in vogue. Since the foregoing remedy has been practiced from 50 to 75 per cent. of those attacked by the disease recover. The disease is prevalent only during hot weather, and seems to principally affect the brain. It is doubtless brought on by exposure to the sun either while working or grazing.

ILLINOIS.

Mr. S. P. THACKER, Vienna, Johnson county, says:

Horses and mules have been affected with what is known here as periodic opthhalmia. The first cases that came to my knowledge were in January, 1875. Only two or three cases occurred then. The disease has since become prevalent, so that there are numerous cases now within my knowledge.

The animal is attacked with inflammation and swelling of the eyes, nearly invariably beginning in the left eye; then, within from twenty-four to thirty-six hours the right eye is attacked in the same manner. The eye runs a clear, thin, watery fluid, and in some cases matters. While inflammation is in the eye the light seems to be painful to that organ. The inflammation lasts three or four days; then subsides, leaving the pupil of the eye of a milky color. In the course of four or five days the eye becomes apparently well again. The animal becomes nearly blind during the attack, but can see again very well after the attack is over. Some have become blind in one or both eyes after the fourth or fifth attack, which occurs at intervals of from three to seven weeks. The cases of longest standing seem to become more severe and of longer duration; but the attacks are not so frequent.

It is thought by some of our veterinary surgeons that the disease is hereditary, but I notice that stock of entirely different pedigrees are attacked by it. Bathing the eyes in warm salt water appears to be of more advantage than any other remedy yet tried. This allays the inflammation, but does not prevent the recurrence of the disease.

Mr. J. B. TURNER, Jacksonville, Morgan county, says:

The main diseases among farm-animals, which I have personally observed, are the epizootic in horses and the cholera in hogs. In regard to the former, before it reached us, I had made up my mind that its real cause was misunderstood, and its treatment by

close stabling all wrong, for I noticed that the disease in the West passed over the out-door horses on the farms and attacked only, or chiefly, the close-stabled horses in the towns and cities. At that time we had some three or four horses at home, and some sixty or seventy on the farms, most of which we had always kept in stables. Therefore, before the disease came around, I hired some vacant adjoining grass lots in the city, into which I turned all our horses (for the first time out of doors) in November, and let them lie out all winter. I fed them in the lots, allowing them to go under shelter only when they chose to do so to get out of rains and storms. I ordered the same treatment of the animals on the farms. The result was, that while the disease raged violently all about us, especially in the city, even in adjoining stables, it gave us no trouble whatever. We gave them no medicines, and did nothing else whatever for them. This is but a single case; but these are the facts, and they must pass for what they are worth. Other horses failed, and fell in the streets on all sides of us almost every day, insomuch that they were compelled for a time to stop the running of the street-cars, which passed directly by the lots where my horses were quartered.

Mr. GEORGE L. OWEN, Bainbridge, Williamson county, says:

In this part of Illinois horses and swine are more subject than any other kind of farm stock to diseases which frequently either prove fatal or greatly diminish their value or usefulness. Affections of the eyes of horses are quite common, and frequently terminate in blindness. There is a great difference of opinion among farmers as to the causes of blindness in these animals, some attributing it to one thing and some to another. For instance, the feeding of Indian corn, unshelled, to colts and young horses, is thought by some to be the principal cause, while others are of opinion that a small, long tooth without roots, inserted in the gum of the upper jaw between the bridle-tooth and grinders, is frequently the cause of blindness. I have had the so-called blind-teeth extracted when symptoms of blindness manifested themselves, with apparent benefit to the animal, while others in which they were allowed to remain, though having similar indications, finally got well. In some instances blindness is undoubtedly hereditary, and stock-breeders ought to be very careful in the selection of animals for breeding purposes.

Big-head is another disease which prevails to some extent. It consists, when in an aggravated form, of an enlargement of the whole head, and particularly of the bones of the face in a direct line from the eyes to the nostrils. The disease in some instances seems to be hereditary, while in others it appears to be the result of exposure and bad treatment; but whatever the causes are that produce it, it soon impairs the usefulness of the animal, and if not cured renders it useless and frequently shortens its life.

Other diseases, such as distemper and fistula, are quite common, particularly distemper, which is prevailing at the present time, and which, although not often fatal, renders the animal of no use while affected. In fact horses are subject to so many diseases that the keeping of such stock is a rather unsafe business. While horses are peculiarly liable to disease in this part of Illinois, cattle and sheep are almost exempt from diseases of every kind.

KENTUCKY.

Mr. W. A. HELM, Sugar Grove, Butler county, says:

The principal disease to which horses are subject here is a contagious distemper, which is most prevalent in the spring of the year, but frequently returns in the fall. The disease prevails throughout this State, and perhaps others. The first symptom is a slight cough, which continues until it renders the animal unfit for use. Loss of flesh, stupidity, and apparent laziness are characteristic. If the animal does well, after coughing for some days, it will eject large lumps of matter from the nostrils; but if the disease assumes a fatal form the throat becomes swollen, until breathing is almost stopped. It is not often fatal, but it frequently affects the breathing of the animal to such a degree as to injure its sale and use.

Dr. J. G. HART, Murray, Calloway county, says:

A disease uniformly fatal to horses has prevailed in this section for two years. It appears to be propagated by actual contact with matter or virus, inasmuch as animals kept separate though near the disease are not liable to take it. Some regard the disease as cold distemper, while others believe it to be glanders. The symptoms are about as follows: At first fever, which is soon followed by a dry cough and a nasal discharge resembling that from ordinary distemper. There is more or less enlargement of all the glandular organs so far as can be observed. Constitutional disease soon sets in, which is denoted by the change in the nasal discharge from a watery to a gleety and offensive flow. The animal loses flesh rapidly; the skin soon becomes thick and eruptive; the lymphatic glands throughout the body become much enlarged, but never soften or suppurate; the submaxillary and sublingual glands are most especially in-

volved, at least in most cases to the extent of suppuration and softening. The duration of the disease is from two to twelve months. It is invariably fatal. Quite a number of remedies have been used, but without success. Veterinary surgeons have been employed with like ill success.

LOUISIANA.

Mr. SIDNEY GREIG, Vermillionville, La Fayette parish, says:

Until within the last few years no fatal epidemic was ever known to exist among our domestic animals. But now, on the return of the spring and summer months, we have a disease which attacks horses and mules, and sometimes cattle and sheep, and is very fatal. From the rapidity of its action there is rarely time to administer any remedy, and if any is given, not knowing the nature of the disease, it is only a lick in the dark—death is certain. The disease is endemic in its nature, confining itself one season to a certain locality, when it will disappear, and the next season it will make its appearance several miles off. I have been a careful observer of this disease, for I have been one of the sufferers from it, and will give you as exact a diagnosis as I possibly can. The symptoms are drowsiness, loss of appetite, and fever. As the disease advances the animal becomes restless, and walks continually, although without seeming to suffer any great pain until the last hour preceding death, when the agony is intense and pitiable to behold. In the last stages a profuse sweating ensues, and the animal shakes as if in a congestive chill, and soon falls and dies. A *post-mortem* examination reveals the whole internal organs a mass of congestion, and the heart, liver, lungs, and intestines covered with a yellow, jelly-like substance. Neither a preventive nor a cure has as yet been found for the disease. The only preventive seems to be found in the removal of the stock until cold weather sets in. After careful consideration I am fully convinced that it is a malarial disease, similar to that which affects the human family, but of a much more violent character. I have no doubt if like remedies could be applied in the beginning of the attack many animals could be saved. The causes, in my opinion, have the same origin as in cases of malarial or intermittent fever which afflicts the inhabitants of Lower Louisiana, viz., the want of proper drainage, the use of impure drinking water, and the lack of proper care, especially of our work animals, for it is this class that suffer the most. The duration of the attack is from six to twelve hours.

When this disease makes its appearance, had we a competent veterinary surgeon to make a careful investigation of its symptoms from the first stages until the final act, and a scientific *post-mortem* examination held, there can be no doubt but it could be robbed of its present terrors, and many a poor man's heart caused to rejoice thereof.

MASSACHUSETTS.

THEODORE S. VERY, V. S., Boston, says:

I regret that I cannot, from experience, relate facts about the contagious diseases of cattle, sheep, hogs, and fowls. Having resided always in this city, somewhat remote from farming and stock-raising districts, my practice has included for the greater part only the treatment of the diseases of the horse. Of these there are not a few concerning which a large amount of practical good would arise from a more thorough and positive establishment of the causes leading to their development and propagation.

The epizootic influenza of the fall of 1872 caused an immense aggregate loss by death, by loss of services while animals were sick, and in depreciation in values where the effects of the disease lessened the vitality of horses for a long time subsequent to its first attack. Possibly a thorough search for its causes might prevent a similar general outbreak, and inquiries having such an end in view should receive the attention, the support, and encouragement of the general government.

The disease known as the cerebro-spinal meningitis occurs as an epidemic among horses, and is caused by a peculiar poison affecting the system in a specific manner, producing like symptoms—differing, of course, in degree—in all cases. Nothing is known concerning the exact nature of this poison, any more than of some others producing disease in a similar way. It causes great losses to horse-owners in seasons when it prevails, and has occurred extensively in certain localities, at different periods, for the past five years.

Glanders in horses—a most contagious, deadly, and incurable disease—has been quite prevalent in Boston and vicinity during the past five years. The poisonous particles of the disease are seldom entirely removed from stalls and stables where horses having the disease have lived. In my opinion this malady might, under certain conditions, become quite general. If it should, the danger therefrom would be incalculable. Stringent State laws should insist upon killing every animal so affected, and provide

for the unmistakable removal of every trace of the disease from stalls and stables where it has existed, under the supervision of some qualified person.

A number of other diseases of the horse, the prevention of which is possible and of great importance to the public welfare, continue to exist.

MISSOURI.

Mr. JOHN M. CHAPMAN, Charleston, Mississippi county, says:

The fistula, a terrible and offensive disease, makes its appearance on the withers of the horse just at the top of the shoulder-blade, at first upon one side only, but if the progress of the disease is not checked it will finally pass to the other side. A bruise of some kind is nearly always its cause. This the horse may receive in various ways, by striking the top of his shoulders in passing under a low stable-door, by bites from another animal, by rolling on stones or roots, or by an ill-fitting saddle. The disease is easily cured by the use of the following remedy: Take one-half bushel of may-apple root and pour over it about four gallons of water, and boil down to one gallon. Strain this, and mix with it about one-half gallon of old grease. Place the mixture on the fire and stew down to one gallon. During this process throw into it about one-half pint of salt, then let it cool, and it is ready for use. It should be applied with a mop or brush every morning, but the sore should be washed clean the night before. An application of this remedy will cure almost any case of fistula in from two to six weeks.

Founder prevails to a great extent in this locality. The first noticeable symptom is the restlessness of the horse and frequent shifting of the fore feet. The pulse is quick and his nostrils have a red appearance. The horse indicates his sufferings by heavy grunts. He does not stand long upon his feet, but cannot lie down in the usual manner. After making several efforts to do so he will rise up, turn round, change his position, and resume his feints to lie down. The remedy for this disease is to bleed freely without delay. Let the blood run free, and take at least a gallon of it. The object of this is to draw away the blood from the overloaded vessels of the feet. Always bleed in the neck. After this prepare a kettle of hot salt water, and drench with it as hot as the horse can bear it. Next bathe his feet and legs with it, and rub them well with a rough cloth. Make this application three or four times in the course of an hour, and then rub well around the edge of the hoof with turpentine. Do not attempt to work the animal until he gets entirely well. Another remedy is to pour the frog of the foot full of turpentine, hold it up, and burn the turpentine out. This is a little barbarous, but it is an infallible remedy.

Pole-evil is a tumor that comes on the head, or, more properly speaking, on the extreme forward part of the neck, just back of the ears. It is generally caused by being struck on the head by an enraged groom, and if it produces no other bad results it is sure to raise a large lump. I do not know of a case that ever caused death, but if not checked, the disease will render the horse unfit for use. The same treatment as in fistula will always effect a cure.

MISSISSIPPI.

Mr. J. TOWELL, Rankin county, says:

A disease called charbon killed half the horses and mules and many cattle in Rankin county, Mississippi, and vicinity, in 1867. The same disease is reported to have prevailed fatally for the past two years in some parts of Louisiana. This disease partakes somewhat of the symptoms of erysipelas in the human family, being characterized by local inflammation, pain and swelling in some portion of the animal's body, most frequently in the neck, breast, flank, or sides, and is very readily communicated from diseased animals to healthy ones by house-flies, which carry the virus from one to another. But my purpose is not to give a treatise on the disease, but simply to point to a remedy that proved speedily efficacious in nearly every case in which it was employed. Fish-brine is the remedy, and it was used as a local wash to the inflamed parts. Much friction was used and the surface kept wet with the brine until the animal was cured. It is necessary to keep the animal in the shade (stabled) and protected from flies while under treatment. Epsom or Glauber salts were employed internally, given in sassafras-tea when the case was obstinate. Three-fourths of the cases treated yielded readily to the fish-brine wash alone.

NEW JERSEY.

Mr. E. STOKES, Berlin, Camden county, says:

We have been exempt in a great measure from diseases among our farm animals in this immediate vicinity for some months, except a disease affecting the horse. This

malady is very fatal, and a number of horses have been lost in the southern portion of this county and many in Atlantic county. They are taken suddenly with great weakness, and in many cases very soon after eating a full feed are unable to stand, and in four or five hours become perfectly blind and experience great difficulty in breathing. They die within from twelve to twenty-four hours. Almost every case has proved fatal. Mares seem much more liable to be attacked than horses. I have heard of no mules being attacked by the disease. Horses in prime condition are as liable as those that are not, and young ones are rather more liable than old horses. I think the disease is somewhat on the decrease at this date. Some localities are entirely exempt, while it may prevail on almost every side. Should the disease become general, it will prove much more serious than any malady we have ever had among our horses.

Mr. John Frost, Hoboken, Hudson county, says:

Our horses have suffered greatly by epizootic, which seems to have been chronic, for the last three years. The symptoms are as follows: The eyes became dull and heavy, the glands of the throat swollen, loss of appetite, followed by a copious discharge of mucus from the nostrils. My system of treatment was as follows: I had my stable thoroughly cleaned, and gave it several good coats of whitewash prepared from ordinary lime. I then fumigated it once a day by burning pine-tar, being very careful to close the door and keep all the smoke possible from escaping. About noon I would prepare a feed for them by scalding about three quarts of wheat-bran, and after adding about one gill of cider vinegar would feed it to them warm in a nose-bag. If they refused to eat they at least inhaled the steam from the food. This treatment seemed to bring them back to their appetites. I fed them young carrot-tops, which they devoured with avidity. At the end of four or five days with this treatment the horses were ready to go to work again. Some of my neighbors refused to follow my treatment and called in veterinary surgeons, who were in most cases from four to five weeks in getting the horses on their feet again. In a great number of cases very valuable animals were lost, while my own thrived and recovered their wonted spirits and strength in most cases in less than a week.

Horses in this district suffer greatly from inflammation of the bladder, brought on in most cases from fast driving or heavy pulling. The symptoms that have come under my notice are as follows: The horse frequently stretches and attempts to stale, but cannot. I have tried niter and gin, in fact all ordinary prescriptions given by veterinary surgeons. They failed, and I resorted to my own treatment, which is as follows: Take about twenty-five or thirty roots of parsley, stew them in about three quarts of water, strain them through a colander, and give the horse as a drink one pint every half-hour. The second or third dose has never, in my experience, failed to relieve them.

James C. Dustan, V. S., Morristown, Morris county, says:

The appearance in this section of a new and unusually fatal disease among horses has prompted me to report to you some of the facts connected therewith. It may be more common in other parts of the country, but here it is new to our profession. The first case occurred about the middle of last month in the adjacent village of Madison, and up to the present time twenty-one horses have been attacked by the disease in that place. Of that number eight were under my professional care. Four of these have died and the others have recovered. Of the remaining thirteen, only one has recovered. The disease is of short duration, lasting, in the cases that prove fatal, from two or three days to one week. The general symptoms are as follows: For the first day or two the horse seems inclined to droop, and, without any apparent cause, acts tired. Then a difficulty in swallowing is noticeable, which increases as the disease advances. The fever is high; obstinate constipation of the bowels, and almost complete suppression of the urine, the latter fact being ascertained by means of the catheter. The manner in which the act of swallowing was effected made it clear to my mind that the inability to do so was caused by a partial paralysis of the muscles of deglutition. Generally, when the horse lies down, he is unable to rise without assistance. There is also a marked tremor in the left fore shoulder, and, although not constant, has been noticed by me in all the cases I have seen. *Post-mortem* examinations in four cases have disclosed the following anatomical lesions: The most prominent is an intense inflammation of the larynx, extending for some distance down the trachea. The kidneys were found to be in a state of congestion, and in one case considerably hypertrophied. There was also found inflammation in the nasal fossæ, but more particularly in the left. The brain, œsophagus, and spinal cord were found in a state of perfect health, as were also all the other organs of the body. I regard the disease as one of blood-poisoning, introduced into the system from the atmosphere, and, as far as I have been able to ascertain, it resembles in a striking degree diphtheria in the human being.

My treatment consists, first, of a blister of cantharides applied to the larnyx region, and kept open for several days by mild mercurial ointment; dry cupping over the kidneys; the administration of linseed-oil as a laxative, aided, if necessary, by injec-

tions, and the following prescription given every four hours, viz: five drops extract of belladonna, one ounce of water, and one-half drachm of iodide of potassium. This is for one dose.

To the above prescription was added, for fever, tincture of aconite, and after a day or two, dropping the aconite, I gave quinine sulph. grs. x, every three hours. The use of iodide of potassium should be continued until the functions of the kidneys have been fully restored. I also found benefit from the free use of chlorate of potash. The diet should be of the most nourishing kind, and by every possible means the strength of the animal should be supported. As a drink, hay-tea is preferable to plain water. But the best treatment I could give, together with careful nursing, shows as a result a fatality of 50 per cent.

NEW YORK.

Mr. FRANK D. CURTIS, Charlton, Saratoga county, says:

In this high latitude (43° north) epidemics among farm animals have been rare. Horses have suffered the most, and undoubtedly this has been caused by the hard work which has been required of these animals, and the severe and trying conditions to which they are often exposed, stimulating contagion and laying the foundation for other diseases. About fifty years ago an epidemic prevailed generally among horses which was called "black tongue," because the tongues of horses afflicted with this disorder became swollen and turned black. In the worse cases they were unable to eat for a few days, or until the inflammation had subsided. Physic was generally administered, and a soothing lotion applied to the tongue. The tongue was often so swollen as to hang out of the horse's mouth. This malady did not continue but for a few days, and death was rare.

The next epidemic which was at all general in its character was the epizootic, or influenza, which swept over the whole country in the autumn of 1872 to such an extent as to paralyze business. Oxen were substituted in the cities, as far as possible, to perform the duties of the horse. In most cases, where care was taken not to expose affected animals to cold, or to require them to labor when in a feverish and weakened state, they recovered. Many, however, were left with a cough and weakened lungs, which made them afterward susceptible to colds and the more acute attacks of pneumonia. This disease first attacked the pulmonary organs (throat and lungs). During the past season a mild form prevailed, which seems not to have been fatal in any instance. The symptoms were a hacking cough, with a poor appetite, and a staring coat. Cathartics were administered in some cases with favorable results. In most instances no treatment was had, but the animals lost flesh and came out in poor condition.

Distemper.—A distemper often breaks out called "horse distemper," which, in some cases, is no doubt caused by a cold, and often becomes contagious and runs through a neighborhood. There is no other way to account for the appearance of this disease in an isolated neighborhood where there has been no possible exposure. It is characterized by running at the nose and swelling of the glands of the throat, which often become so inflamed and swollen that the horse is unable to swallow anything for days together, and liquid preparations of food, such as milk or gruel, have to be poured down the throat through a pipe to keep the animal alive. Active fomentations on the surface are applied which reduces the inflammation, and in many instances effects a cure; but in some cases abscesses are formed in the glands of the throat, which must be lanced to allow the pus to escape, for if left until they mature they break and discharge. When this stage is reached a cure is almost certain. The great danger to be feared is that the throat will fill up before suppuration takes place, and to prevent this poultices should be applied. Mild cathartics must in all cases be administered so as to keep the bowels open and lessen the severity of the inflammation and fever. This distemper is imparted to other horses by drinking at the same trough, or by standing in the same stall where an infected animal has left any of its mucus discharges. Actual contact with a diseased animal would also produce infection. The contagion is not conveyed through the air, as it undoubtedly was in the epizootic or influenza of 1872, which attacked horses running in pastures remote from infected animals.

Epizootic, or influenza.—We will now give a number of specific cases of this influenza, with the treatment and the results, and also of other diseases with which we are familiar. Three horses in one stable sick with epidemic influenza; mild cases; animals kept blanketed and the barn clean. Treatment: A mixture composed of chlorate of potash and gentian, equal parts, in teaspoonful doses three times a day, given in the feed. Three drops of pure carbolic acid in their drinking water twice daily; a small quantity of carbolic acid to be dropped on a hot shovel and the horses made to inhale the fumes twice daily. They were fed full rations of oats and given plenty of water with the chill taken off. Every day the animals had walking exercise in the yard. All cured and fit for service in a week. A few onions were fed daily.

Three cases in one stable; all severe; a horse aged twenty years being the worst.

The two younger horses were treated as those before mentioned, with the exception of having hot bran-mashes every night. The barn was fumigated daily by throwing sulphur on hot coals. The old horse was very low. No carbolic acid was given internally. Thirty grains of powdered sulphate of iron were given twice daily, in addition to the chlorate of potash and gentian. The horse became more feeble. After three days one ounce of whisky was given three times a day. The young horses recovered and worked in ten days. They kept their flesh well, but the old horse became much emaciated.

One horse which had been sick a week with influenza, and had been fed aconite, was in a very low condition. Chlorate of potash, gentian, sulphate of iron, and one ounce of whisky three times daily were given. The horse had but little appetite, but was fed all the oats and bran-mashes it would eat; the barn was fumigated. The animal was not able to be used for five weeks, but recovered with no cough remaining.

One horse had been subject to a cough for a year or more previous to attack of influenza. This was a bad case. In addition to treatment previously mentioned the following mixture was given: Fluid extract belladonna, one half drachm; camphor, three drachms; sulphuric ether and linseed-oil, one fluid ounce each; mixed well and given in doses of two teaspoonfuls two or three times daily, according to the severity of the cough. The horse recovered and worked in two weeks. Has had no cough up to this time (1878). A teaspoonful of fluid is reckoned as one drachm, four teaspoonfuls as one tablespoonful, and one tablespoonful as a half ounce, and two tablespoonfuls as one ounce.

Two horses in one stable were slightly affected. They were treated as the previous cases. They were worked hard after the first three days, and the result was that both were left with a tendency to heaves, and one with swelled legs. It was treated with sulphate of iron and bandaging, and the swelling disappeared in about two weeks.

One horse was sick with influenza for two weeks, and no treatment was given. Very bad cough and much emaciated. There were copious discharges from both nostrils; all the legs were swollen; no appetite. The animal was ordered to be kept well blanketed, and given scalded and bruised oats, and to have its legs well rubbed with the hands or a hay-band twice a day, and bandaged; carbolic-acid vapor to be inhaled twice a day. A heaping teaspoonful of powdered chlorate of potash, gentian, and sulphate of iron in equal parts was given daily. For the cough, five grains of camphor, three drops fluid extract belladonna, one-half ounce Hoffman's anodyne three times daily, also three ounces of whisky three times daily. The horse rapidly became worse and died. The animal was not properly cared for, as a broken window was left open, which allowed a cold, damp wind to blow directly upon it. The legs were not properly bandaged, nor the medicine administered as directed.

Spasmodic colic.—The horse had been driven hard and left to stand without being properly blanketed. The bowels were constipated. The animal had been fed rosin and saltpeter without benefit, and suffered severely. Sulphuric ether and laudanum, each one ounce, in a pint of water, were given to allay the pain. In a half hour this dose was repeated. Copious injections of warm water were also given, and the legs were rubbed briskly. The above treatment was followed at the end of an hour with a dose of six ounces solution of aloes, one drachm of aloes to each ounce. A free discharge of the bowels followed in one hour and a half, which relieved the horse from pain.

Colic.—Another case of colic, caused by eating too large a quantity of oats in the sheaf, and a cold. This animal had been neglected in watering, which helped to cause the constipation. Copious injections were administered, followed by a dose of one ounce of sweet spirits of niter and a pound of Glauber salts. A free discharge from the bowels and of urine followed. Scalded oats and hay thoroughly wetted were given for several weeks with most favorable results.

A horse was driven hard in a warm day, and, in a state of perspiration, was left tied under a tree without being blanketed. It showed no signs of sickness that were perceptible until the next day, when it was taken with violent convulsions and died within a half hour, before any remedies could be administered.

In another case of colic, a stranger prescribed Flemming's tincture of aconite root. Two drachms were given, and the horse died in just thirty minutes.

Lampas.—Young horses are often afflicted with a disease called lampas. The muscular bars across the roof of the mouth grow or swell to such an extent as to be on a level, and often to extend below, the incisor teeth. The common remedy is to burn them with a hot iron, or to cut them so that they will bleed freely. The latter is the least objectionable of these two remedies, and does no permanent injury to the animal. Burning produces such a shrinkage in the gums and bars that it causes the animal to look old; besides, it is a cruel practice. Indigestion is probably one cause of this local inflammation, and the cutting of teeth another. Bran-mashes and bruised oats, with plenty of salt, should be given during this temporary trouble. When the bars and gums are so sore that the animal is not inclined to eat, dry food mashes of any kind may be substituted, and the lampas should be treated with a wash of alum-

water, or some other mild caustic; at the same time regular doses of Glauber salts (four ounces daily) should be given to correct and assist digestion.

Strains.—A horse got strained in the legs in a snow-drift, and the right hind leg became very much swollen and was stiff and tender to the touch. Liniments of several kinds were used without benefit. The leg became more tender and swollen. Afterward it was loosely bandaged with flannels and kept wet day and night with alcohol and water, each a quart, with all the sal ammoniac that could be dissolved in it. In a week the horse was well.

Lung-fever or pneumonia.—A horse was driven twelve miles and back and seemed to feel well until near home, when he appeared to tire out suddenly. He had several chills, and his breathing became very quick and labored. He was put into his stall and covered with two blankets, soon after which he commenced to cough. Pulse went up to ninety; by the sound the lungs seemed much congested, the right one the most. Spirits of turpentine was rubbed in over both lungs, followed by an application of cloths wrung out of boiling-water, which were held against the chest. Ten drops of fluid extract of digitalis were given every four hours. No hay was given, but plenty of water with the chill taken off. Oatmeal-gruel and warm bran-mashes were fed twice daily; a teaspoonful of powdered saltpeter was administered three times daily. Next day the animal breathed easier, and the rubbing with turpentine was omitted. The digitalis was continued for two days, and then reduced to five drops, and chlorate of potash was substituted for the saltpeter. Six days after the pulse was normal, and the digitalis was discontinued. The following medicine was then administered for three days (three times daily): A teaspoonful of chlorate of potash, nitrate of potash, and gentian of equal parts. At the end of this time the horse appeared well and fit for service. The medicine, however, was continued for a week longer with full rations of oats. In treating this affection it is very necessary to act promptly. A half hour wasted at the beginning is as good as three days added to the progress of the case. The engorgement of the lungs often rapidly increases, and the horse may be beyond all help very soon. Counter-irritation should be immediately made use of, as it greatly relieves the lungs. It is not necessary to blister, unless counter-irritation does not help. Counter-irritation should be kept up for at least two hours, and longer if this does not relieve the breathing. If the breathing becomes bad again, repeat the irritation.

The old plan was to bleed copiously and immediately. This idea is about discarded in the treatment of human diseases, but the old-fashioned horse-doctors still stick to it. It is, however, a bad practice in these cases. It does not reduce the pulse unless carried too far for the safety of the patient, and the animal needs all its blood to sustain it. Where bleeding has been practiced the convalescence of the animal is always more tedious. The pulse can be controlled by the use of the fluid extract of digitalis, in doses of five to twenty drops every four hours, especially if conjoined with niter in doses of one or two teaspoonfuls two or three times daily. Starvation will reduce the power of blood-making, and not depress like blood-taking. As hay is apt to contain dust, which will irritate the already too sensitive lungs, and as it is not needed, it is best not to give it. If the case occurs in summer a few mouthfuls of grass in the morning before the dew is off it is by no means objectionable. In giving the animal water put the pail on the floor, as the horse will drink easier. Where the legs become cold and remain so in spite of vigorous friction, where the lining of the nostrils becomes livid, where the horse cannot be turned or lie down, where counter-irritation does not relieve the breathing and the disease increases in severity up to the fifth day, where the breathing becomes more labored, rattling occurs in the throat, cold sweats appear, and the pulse becomes intermittent or irregular, the horse seldom recovers. Usually, if the turpentine or mustard raises a blister, we are warranted in giving a favorable prognosis; if not, an unfavorable one. Give the horse plenty of air—cool, pure air, not cold. If it is in a dirty, filthy stable, and the animal is continually inhaling the fumes of ammonia, he may recover, but it is doubtful. Let it be understood that these conditions are irritating to the lungs and depressive in their general effects. As soon as the legs begin to feel cold they must all be strongly rubbed at once with the hands and warmly wrapped, not bound in woolen cloths.

Do not give the horse much to drink at a time, but give it often and let him take his time at it. If the bowels are constipated give two ounces Epsom salts three times daily, and aid their action with injections of soap and water. If debility comes on, rub the legs often; give good oatmeal-gruel freely, and a pint of good ale or four ounces of whisky three times daily. It is a very bad sign where the horse loses its sight during the progress of the disease. Horses frequently live that have had no treatment, and some do that have been treated improperly, even when the case has gone on to suppuration; but they are apt to have lung trouble in after years, and most generally heaves or dropsy of the chest. If mild counter-irritants do not relieve, stronger ones should be tried. Mustard and turpentine and boiling water are good, and as strong as anything that is readily obtainable.

Congestion of the lungs.—A colt two years old was taken with congestion of the lungs

without apparent cause, and died of pulmonary apoplexy in twenty-four hours in spite of treatment. The lungs were found engorged with blood, and the heart very much distended.

Another horse had been over-driven, and breathed heavily, with labored action of the heart. *Veratrum viride* was given to control the arterial excitement, but the horse was left with an attack of heaves, owing, probably, to the rupturing of the air-cells in some part of the lungs.

In cases of congestion of the lungs, counter-irritants similar to those used in the treatment of lung-fever should be applied. The bowels should be kept open, and great care taken to prevent the catching of additional cold or exposure to any exciting and irritating surrounding, such as cold draughts or the odor of foul stables.

Heaves.—A horse affected with incipient heaves was treated with a belladonna and camphor mixture, and finally with arsenic, but received no benefit.

Another horse was affected with heaves for fifteen years, and was not cured. He was fed ginger in large quantities, and other farmer's remedies, which sometimes produced a modification of the disorder but no cure. Preventives by wetting the feet and soaking all the grain in water kept the heaves down, so that the horse could be used. Heaves has long excited the attention of veterinarians and of the curious in general, and as the cure of it holds out the certainty of a plentiful harvest both of credit and emolument, it has been a subject of much experiment and more conjecture. People long ago used to indulge in the most extravagant notions respecting it, and at the present day the market is full of nostrums, each lauded as a certain cure of this distressing and perplexing complaint. The cause of heaves or broken-wind is hereditary or constitutional. A certain form of body is unquestionably favorable to its production, and it is from this circumstance that it proves hereditary. The narrowly confined chest and the pendant belly, which mark corn-bred horses and gross feeders, predispose toward the affection. It may be that subjecting horses to a long-continued unhealthy course of feeding on dry food, such as chaff, dry meal, dusty or musty hay, &c., brings it on, as does working where much dust is necessarily inhaled. It is seldom the immediate cause of pneumonia, but frequently it results from those conditions of disordered respiration which succeed to it, as thick wind, chronic cough, &c. We are much in the dark about its origin, but observe that it gradually grows on a horse, occupying months and even years with a slight occasional cough which, ripening into a state of impeded respiration, at last ends in broken wind or heaves. We often see it follow abuse. We can see it also follow one hard gallop; and we can leave a horse well one day and find him broken-winded the next.

With these facts in our every-day experience, can we name any universal cause? My impression is that there are two kinds of heaves or broken-wind. One is due to an injury to the sympathetic nerve, the other to a rupture of the air-cells of the lungs themselves. I believe that the first-named variety may sometimes pass into the second. A *post-mortem* examination in most of the subjects revealed lesions and distension of the lungs. We need not have looked farther for the cause, but it is not by any means uncommon to meet with broken-winded or heavey horses whose lungs after death are neither emphysematous or otherwise structurally deranged, and which, with the exception of their lighter color and occasionally greater bulk than natural, cannot well be distinguished from the sound lung, although they may crackle when pressed by the hand. The injury to the sympathetic nerve would cause derangement of the digestive canal, as well as produce the irritability of the larynx, which has favored the opinion regarding the lungs as the original seat of the disease. Horses with heaves or broken wind will eat almost anything, which again favors the idea of injury to the sympathetic nerve. The symptoms of this complaint are well marked. The cough and the manner of breathing may be considered as conclusive. The sound emitted by the cough is peculiar, and is often forced out with a kind of a grunt, in a short, vibrating but feeble tone, compared with the usual cough of sound-winded horses. The breathing is conducted with a remarkable difference between the inspirations and expirations. Inspiration is effected quickly, and the lengthened, laborious strain of expiration, which is performed by two distinct efforts, in one of which the usual muscles operate, and in the other the abdominal muscles come into violent action to complete the expulsion, after which the flanks fall with a peculiar force, and the air is again breathed in as by a spasm. An auxiliary symptom is the peculiar flatulence of every heavey or broken-winded horse, which is strikingly characteristic of that disordered state of digestion so common in these cases, and of that constant thirst also, which is invariably present.

Cases taken in the early stages are sometimes cured, but in most cases the treatment can seldom be more than palliatives. Whatever increases the distension of the stomach and bowels aggravates the complaint by increasing the difficulty of expanding the lungs. Therefore avoid stimulants and promote regular evacuations. Abstain from over-distension of the lungs by too violent and too sudden exertion, particularly after eating. By carefully attending to these principal indications, a broken-winded or heavey horse may be rendered comfortable to himself and useful to his owner. The

food should be regularly given, in moderate quantities only; but most particularly it should be of such a nature as will contain much nutriment in a small space. Do not give much hay, and let that be entirely free from dust and well sprinkled with water. Corn-fodder in small quantities is sometimes advisable, particularly as much water is not required with it. Turning out to grass and neglect of moderate exercise commonly aggravate the complaint. Give water sparingly, particularly in the working hours; at night a moderate quantity should be allowed. Never let a broken-winded horse drink his fill at a pond or trough. Benefit has frequently been received in the earlier stages from the cough-mixture of belladonna, ether, and camphor; also from small daily doses of digitalis—ten drops of fluid extract in two doses. Arsenic and other tonics are sometimes of benefit.

Wounds and sores.—A lump appeared upon the shoulder of a horse, which grew larger and was very tender, and finally formed an abscess. A self-styled horse-doctor opened the abscess and pressed out its contents, and injected into it some fluid which, from appearances, was an arsenical preparation. The leg of the horse on that side became badly swollen and painful. Fomentations of witch-hazel tea and of belladonna leaves were used, and chlorate of potash was given internally in doses of half an ounce three times daily. After a few days pus was detected as having followed the muscle down the leg, when it was lanced and a free exit given.

A mare, heavy in foal, running in the barn-yard, was kicked by other horses. The horses were sharp shod, and made a great many deep and ugly wounds. Currier's oil was immediately applied to the cuts. They were kept smeared with it, and healing rapidly took place. The animal recovered without any injury except scars, as the wounds happened to be all in the fleshy part of the body.

A colt running in a yard caught its head between the ears on a nail, and cut its face the entire length to the end of its nose. The skin stretched apart at least an inch in width. The edges were sewed together with a strong thread and Currier's oil frequently applied. This ugly wound healed without any perceptible scar.

A distinction should be made between flesh cuts and wounds, and those where prominent veins are punctured or severed, which require a different treatment and will be treated under a different head. Wounds are often severe and of the most dangerous character, resulting in the crippling of animals, and often destroying their usefulness. If of a severe nature they affect the general health and condition of the animal injured more or less, and treatment other than of a local character is often necessary. Accidents of this kind injure, and often ruin, more horses than all diseases combined. In introducing caustic fluids into a sore care must be taken that they are not put in such positions that they may not readily run out. Solid caustics are much safer. Wounds and injuries cause inflammation which may be severe enough to kill, or so slight as to cause no discomfort. Local inflammation is characterized by heat, redness, pain, and swelling in the part affected. According as such inflammation is considerable or inconsiderable, the circulating system universally participates, or it is not excited. The general circulation is also increased according to the circumstances connected with the structure and functions of the part injured. When the general circulation is increased, the condition is called symptomatic fever. The vessels of the inflamed part are always distended. Sometimes in a clean cut, after the bleeding has subsided, a fluid is thrown out, the parts are stuck together, and the wound becomes closed. This is called healing by first intention, or adhesion. When the wound, or the inflammation consequent upon it, is too severe, or the loss of substance too great, the edges become covered with minute pimples or granulations, a fluid called pus is secreted, and the wound gradually becomes filled with these new bodies called granulations or second intention.

When the inflammation is torpid, instead of healthy pus the wound secretes a substance which appears somewhat like the white of an egg, and which may or may not have an offensive smell. Absorption ensues and a loss of substance occurs by reason of the ulceration of the margins of the wound. Occasionally, however, the inflammation is violent and the reparative agency almost inactive, in which state the inflammatory congestion may rupture and destroy the small vessels supplying the wound. The blood is thrown out into the wound where it rots, and mortification is said to have come on. These terminations of local inflammation must be borne in mind when treating it. In most instances adhesion is to be desired. If there has been much shock do not bleed, as it aggravates the depression. Better give a draught of one ounce each of laudanum and sulphuric ether. If there is no shock to the nervous system, give a purgative and low diet. If there has been no bleeding a slight amount of blood taken from the part injured soon after the accident does much good. If there is much heat of the part, use cold water and alcohol applications, with or without sal ammoniac, or sal ammoniac and vinegar. If there is an open wound—especially a lacerated one—warm applications are better. Bathing with warm water or a decoction of witch-hazel leaves, with or without the addition of belladonna leaves, is advisable. It must be remembered, however, that warm applications favor suppuration. After using warm applications the part must be well dried before leaving it, or it will chill.

Let the treatment be either hot or cold it must be kept up faithfully, for if the part has too long a rest reaction will occur and the whole work will be undone. When suppuration becomes unavoidable, promote by warm poultices constantly applied. Care should be taken to renew them as soon as they become cold. If the inflammation is deep-seated, and it is necessary to hasten the formation of pus, turpentine may be added to the poultices. When pus is detected it should be evacuated by a free incision made at the most dependent part of the gathering, care being taken to avoid injury to any important vessel, tendon, or joint by inserting the lancet as nearly parallel to the muscular fibers as possible. As the detection of pus often requires skill, it is better where there is doubt to first insert a grooved instrument called an exploring needle, which will settle the doubt by showing the pus if there is any, and doing no harm if there is none. A wound is a division of the continuity of tissue, and may be either incised or cut, contused or bruised, lacerated or torn, or punctured.

Cut-wounds such as calks, &c.—If the bleeding is excessive, control it. Press the finger upon the wound where the blood spirts, and then as soon as possible secure the large arteries by a ligature of silk or twine. The bleeding from small arteries may be controlled by pressure or by passing a stout pin from without behind the artery and through the skin, and making pressure on the artery by several turns of twine around the end of the pin.

Remove all foreign matter from the wound if possible without washing, as this diminishes the chances of union by first intention. The wound may be sewed up, which is best done by the interrupted sutures or stitch. All the sutures should be inserted before any are tied. Keep the wound clean and as dry as possible. Owing to the tendency of the stitches to ulcerate, they cannot be relied on to remain after the third or fourth day. Wire sutures remain longest, but they must not be too tight. The wound may be brought together with plaster, previous to which the hair should be removed. Sulphate of soda, three parts by weight; quicklime, ten parts by weight; and starch, ten parts by weight, should be made into a thick paste with a little water and applied between the hairs over the part to be rendered bare. This paste should be taken off the skin with a wooden spatula in from one to two minutes. For small wounds use a plaster of collodion spread on linen cloth; for large ones glue will answer. In the other classes of wounds we must look to the suppurative process for repair. During the process of forming granulations the wound should be kept from exposure. No application is necessary to promote the formation of granulations. If luxuriant granulations shoot up above the surface, keep them down with sulphate of copper or a solution of chloride of lime in water, one grain to the ounce. In deep wounds it is of the utmost importance that they heal from the bottom, therefore the premature closing of the external orifice should be guarded against, and the atmosphere excluded by the introduction of a tent of rags or wicking, which should be saturated with a solution of carbolic acid (five grains to an ounce of water), and dried previous to using. These should be changed daily. It is very important to keep wounds open where it is suspected that they contain foreign bodies which cannot be readily reached.

Strains producing curbs, spavins, &c.—Strains may be of various character. In some instances they may be the result of weakening of the muscles, in which the application of astringent liniments and rest will relieve. The same is true when the tendons are strained, unless too severely. Sometimes dislocation of the joints is caused by strains and the formation of tumors and callous swellings, which may be attended with stiffness and lameness. The latter may be removed by blisters, and the former may be greatly relieved by searing either with caustics or burning. Under the head of the latter may be classed curbs and splints, and under the head of the former bog-spavins, &c. For slight sprains or strains, a liniment composed of tincture belladonna, laudanum, and spirits camphor, each two ounces, with alcohol sufficient to make a pint, is good.

A colt was driven with a load in cold weather, and was very much heated. It was put into the stable with its coat all wet, without any currying or rubbing. During the night it became very uneasy, and in attempting to roll in its stall strained both hind legs so as to produce the tumors known as bog-spavin. The colt was unable to walk on account of the soreness. After being treated for several weeks with an application of the liquor extracted from white-oak bark, and having the parts affected seared with a hot shovel, the tumors were reduced and the lameness improved, so that the horse was able to work.

An unshod mare was taken on the ice, where she slipped and dislocated the stifle-joint. Astringent applications were applied and an effort made to return the stifle-bone to its natural place, but in vain. A new socket, however, was formed by nature, but the leg was shortened. The animal did good service, although lame, for a number of years.

An old horse, while attempting to roll in his stall, caught his foot fast and dislocated his stifle. Strong astringents were applied, and an unavailing effort made to return it to its place. The horse stood on three legs as long as possible, when he fell down,

and could never be made to stand up again. He did not live long enough to test the question as to whether nature would have supplied the deficiency or not.

A horse ran away and jumped over a stone wall, straining one of his hind legs and producing a curb. A blister of Spanish flies was applied to the spot, the hair having first been closely cut. The blister removed the excrescence. The sore was afterward treated with lard until healed. No scar or mark was left.

In all cases of the above character active treatment should begin as soon as the first indications of injury are discovered.

Dropsy and abscesses.—A colt, which had had epidemic influenza, was left with a cough and a discharge from the nostrils. This, however, passed away, but the horse was very much run down with a swelling in the sheath and legs. Finally it developed into cellular dropsy. The following prescription was administered (a teaspoonful twice daily): Two ounces each of powdered sulphate of iron and gentian; one-half ounce each of chlorate of potash and powdered African ginger, well mixed. Also three ounces each of sulphuric ether and sweet spirits of niter, one dram oil of anise, and two drams diluted alcohol, well mixed, and a tablespoonful given three times a day.

It was fed well with bruised oats and carrots and oat-meal gruel. Five days thereafter it was turned out for a short time in the middle of the day. It was brought up at noon and the legs well rubbed. No dew or dampness was allowed to fall on him. In six weeks the animal was cured. In another case of the same disease the horse died.

Two horses were out of condition, caused by abscesses. Tonics were ordered, with good feed and rest. They did not get it, and both died.

A horse did not perform well. The owner did not know what was the matter. The lungs were examined, but no inflammation was detected. The respiration was very indistinct. A few days after he began to breathe heavily, and seemed to be in pain about the chest. Remedies which were deemed appropriate were given, but the horse died. On *post-mortem* examination the pleural cavity was found to contain three pails of fluid, and the lung was compressed to one-third its natural size. There were marks of old inflammation on the surface of the lungs. This horse had probably been given injurious medicines while affected with the epidemic influenza.

Blindness.—Blindness, in many instances, is caused by over-draught, which is cruel and too frequent. Sometimes it is caused by cold and inflammation, sometimes by bad teeth which affect the optic nerve, and sometimes by rays of light which fall directly upon the eye through a window. Cases of blindness caused by over-drawing are very common and generally incurable. Foreign substances, such as chaff and beards of barley or wheat, in the eye, often cause blindness, and should be removed as soon as noticed and before severe inflammation begins.

For inflammation of the eye the following will be found beneficial: Sulphate of copper, ten grains; sulphate of morphia, five grains; water, four ounces, mixed and dropped in the eye twice daily.

For amaurosis, arsenic forty grains, strychnia five grains, divided into twenty powders, to be given three times daily.

A broken-winded mare, attacked with amaurosis, was given the preparation of arsenic and strychnia as above, and soon recovered.

A horse was confined in the stable where the sunlight came through a window directly upon his eyes and caused blindness. The cause was not discovered until too late to remedy the evil. Medicines in this case, as a matter of course, proved ineffectual.

Paralysis.—A horse had paralysis of the hind legs. Croton oil and strychnia were ordered, but the strychnia was not given. The horse did not recover so as to be able to work.

Apoplexy, megrims, and blind-staggers.—These disorders are so similar and closely allied that it is difficult to discriminate between them. Megrims, or pain in the head, may be a milder form of apoplexy, caused by interrupted circulation, or it may proceed from some local trouble, such as a bruise. Staggers may proceed from the same cause, or from epilepsy or nervous affection. An application of cold water or ice to the head, which relieves the pain, should be accompanied with an active cathartic. The diet of all animals affected with these disorders should be carefully manipulated so as to keep the bowels open and prevent any clogging in the discharges or in the circulation of the blood. The diet which would keep the bowels laxative would have the effect to keep the kidneys and urinary organs in active condition. Preventives should be closely followed in all cases of this nature, as treatment will not, at the time of the manifestations of the disorder, afford more than temporary relief.

Diarrhea.—Young colts are very liable to attacks of diarrhea. In such cases an enema or injection of starch, containing two grains of opium, is good, and has cured in many instances.

During pregnancy.—A mare well along with foal had been driven too hard. She was taken with severe pains immediately afterward, and died during the night. Another was overworked, which caused her to abort, from which she finally recovered. Another mare had chills after foaling. A good dose of ginger and covering with a

blanket broke the chills, and she recovered. Another, six weeks before foaling, began to swell under her belly. In a short time the belly settled down and the swelling increased. Ten days before her foaling time she aborted. The muscles were either so much relaxed or torn apart that her belly never resumed its natural shape. She has been barren ever since, a period of several years. Had she been bandaged before the swelling and depression became so great, she probably would not have lost her colt or been permanently injured.

Foul feet.—When horses are left standing for a long time on manure, the feet are apt to become foul, often resulting in thrush or canker and causing lameness. When not promptly treated it becomes a very troublesome disease. Clean stables are preventives of this trouble. When the foot is found to be foul, which may be known by the smell, it should be thoroughly washed and a strong solution of carbolic acid applied daily. The soreness is located at the heel, under the frog. Sometimes it may be necessary to cut away a portion of the frog in order to reach the seat of the canker.

Scratches.—This is a common disorder with horses which are required to travel on muddy roads or on the farm, where the feet are daubed with mud and soil, and are not cleaned. The dirt irritates the skin and poisons it, causing cracks, which become inflamed by the continued poisonous irritation of the soil. If the horse's feet and legs are washed clean every night when brought into the stable, all danger may be obviated. But when affected, the feet and legs should be carefully washed with castile or carbolic soap and oiled, and the animal kept in the stable until well. Aggravated forms of this disease have been cured by painting the spots affected with white-lead. It is well to add laxative food and complete rest.

Founder.—This general name is given to any disorder or inflammation affecting the feet, cords or muscles of the fore legs, which causes lameness. A spirited mare was lame in the fore legs and was gradually growing worse. She was treated at first for a sprained shoulder, by cold-water sweats on the shoulder, followed by a turpentine liniment which blistered the parts. An incision was afterward made in the skin and air blown in at a point where it was thought there was a shrinkage of the muscles, called sweeny. A liniment composed of laudanum, camphor, and alcohol was rubbed in afterward, but without avail, as the lameness grew worse. Finally, it was determined that the stiffness was caused by being chilled in the breast. She was first bled from the large vein in the neck, three quarts of blood being taken. A rowel or seton was put in the breast, which was turned every day for three weeks; Venice turpentine was put on the seton every day before it was turned, to promote active discharge. A hot bran-mash was fed daily, and in it there was dissolved, for three days in succession, one tablespoonful of saltpeter. After three days a tablespoonful of saltpeter was given once in a week. One ounce of sassafras was steeped in a quart of water and given daily in the mash. Every day the fore feet and legs were soaked in a tub of hot water, as hot as the animal could bear, thoroughly rubbed and then wrapped or tightly bound in flannel cloths. The feet were bound up and kept so all the time in cow excrement, in which a little salt had been mixed. This treatment was followed vigorously for four weeks, and resulted in a cure.

PENNSYLVANIA.

Mr. R. S. Brown, Bethlehem, Northampton county, says:

Since the epizootic malady some years ago among horses, the most fatal disease, and the worst one that we ever experienced, was the spinal disease among the same class of animals. The horse would be taken out of the stable apparently well, and after being driven a mile or two would fall down, completely paralyzed, and unable to get up behind. As this disease appeared in the early part of winter, during snow and bad roads, unless within calling distance and with the assistance of a dozen strong men, the animal was in danger of perishing on the spot. I have taken mine home on low sleds, rolled them off into large and warm stables, padded them all round with straw to keep them from knocking their brains out in their frantic efforts to get up, and then used the following remedies with success: I took an empty salt-bag and filled it with clover-heads. Upon this scalding water was poured, and it was then applied to the skin as hot as could be borne. This was renewed every half hour by careful men during the whole night. The horse was then rubbed dry and a mild laxative medicine used for a few days. After that the horse was raised to his feet by means of a side of leather to which was attached rings and pulleys. This was done at intervals of six hours. The horse was allowed to stand about thirty minutes, when he was let down again, and this operation was then suspended for eight or ten days. If left to lie without being compelled to stand up they will never recover. Veterinary surgeons, who tried the old remedies of bleeding and purging, and applying turpentine to the spine, lost every horse so treated.

TEXAS.

Mr. E. A. PERRENOT, Rockport, Aransas county, says:

The prevalent disease among horses in this country may be designated as bots, distemper, fancy, and sand disease. Of the first two little need be said, from the fact that they are diseases common with and familiar to every locality; but of the latter two a thorough investigation and diagnosis would be time and money well expended.

The first mentioned—the fancy—first makes its appearance in our section as a mild distemper, something similar to the epizootic (which is rarely fatal here), but soon assumes a virulent and malignant appearance, attended by copious discharges from the nose, which soon become very poisonous and offensive, so much so indeed that horses confined in stables where the virus may have been deposited several years before readily and almost invariably contract this exceedingly contagious disease. In a comparatively brief time lumps form on various parts of the body, the glands of the throat and urinal organs become swollen, and the lumps, when opened, discharge matter, and the parts affected become a foul, offensive ulcer, from which seedy-looking bunches sprout. Matter may be squeezed through the skin; the appetite fails; sometimes the muscles of one or more of the legs will become so contracted that the animal will be unable to put his feet (on the affected leg or legs) to the ground, and the eyes having assumed a glassy appearance the animal soon dies. This disease may linger for months, but is always and inevitably fatal. If anything will cure the malady it is unknown here. The body of the dead animal, when opened, is never found to contain a drop of pure blood, it having congealed in the veins into a thick, putrid, viscid, corrupt bloody matter.

In regard to the disease which I have termed sand disease, and which within the past twelve months has become somewhat prevalent and familiar to the people of Western Texas, I will preface my remarks by saying that although I am satisfied it has prevailed in our section for several years past and many valuable animals have been lost by it, yet up to a comparatively recent date nothing was known concerning it, and I can perhaps offer a more lucid explanation of this disease by giving a history of its discovery here than in any other way. For about four years past the grass has been very indifferent, and consequently fails to absorb the amount of salt from our moist salt atmosphere that it did when the grass was luxuriant. I merely mention this as a probable explanation of the cause of the horse eating sand, and which no doubt results in a morbid appetite that craves it, similar to that which causes some children to eat dirt. But to the case in point. A widow lady of our city, a professional midwife, had a very fine horse which, from the nature of her profession, she kept up continually, though giving him the freedom of a town lot 100 by 200 feet. She gave him all the corn and oats he would eat. As to the amount of fodder and hay the horse received, that I failed to inquire into, although since that event many valuable horses have died with the disease that were regularly fed both fodder and hay. But to resume my narrative. This animal was taken sick, and in a few days afterward had every appearance of the scours, for which flour and water was administered. A day afterward it was noticed that the animal was passing sand, and injections were freely administered with strong purgatives, which relieved him of over a peck of sand; but notwithstanding this the animal died within a few days, and upon being opened his paunch and stomach were found to contain over a peck more of sand. It was dry, hard, and clotted into an immovable mass, leaving but a very minute channel over the sand, which was coated by the flour previously administered.

This occurrence, being the first of the kind, attracted considerable attention, and I published an account of the case in our local paper. A few weeks after two very valuable mules, belonging to a Mr. John Burnett, were taken in the same way, and although temporarily relieved by purgatives and injections, the treatment was no doubt commenced too late, and both animals died within three days after the first evidence of their sickness, and upon being opened were found to contain at least a half bushel of sand each. Since then numbers have died, and all have been found to contain sand. By observing animals affected with this morbid appetite they have been seen to eat sand ravenously, and Dr. R. A. Nott, a prominent physician, avers that the same disease prevailed in the locality in which he resided in South Carolina years ago. Ours is a sandy soil, and from its proximity to the bay contains saline properties to a considerable extent, being a point which makes out between Aransas and San Carlos Bays, twelve miles from the Gulf of Mexico. However, I have heard of the same disease prevailing in localities far removed from the salt water.

The only successful treatment that has as yet been discovered is an original and rather violent one, practiced by a young gentleman in our neighborhood of a rather practical turn of mind. It is to attach an ordinary garden-hose to his watering tank, and, inserting the nozzle (about 12 inches long) to its full length in the fundament of the sick animal, turn on a full head of water and thus drench out the sand. In this way he has succeeded in saving several very fine animals.

Mr. J. L. SEARS, Valley Mills, Bosque county, says:

We lost a few of our horses and mules last winter by a disease called blind-staggers, and this winter a good many work animals, both horses and mules, have died from a similar disease. It is supposed to be caused or superinduced by worm-eaten corn. I lost one horse and had several others attacked by the disease, but relieved them by smoking with pine-tar, woolen rags, and red pepper, and by giving them large doses of bromide of potash. I also bled in the neck. A very strange thing about this disease is the fact that every horse attacked loses the sight of his left eye, yet you cannot detect any difference in the appearance of the eyes. They both look natural, yet the animal cannot see one particle with the left eye. They will not see you if you approach them from the blind side, but as soon as you show yourself on the right side they become alarmed, wheel from you, and throw themselves against the walls of the stable with such force as often to knock themselves down. When in the lot they will continue to turn round in a circle until they fall, and then, unless promptly treated, will die in a few hours. Out of twenty attacked in this neighborhood ten have died. Since quitting corn as a feed and substituting oats my animals have done well.

Mr. L. D. VAN DYKE, Clarksville, Red River county, says:

The most serious disease affecting horses and mules, and causing serious loss among these animals, is called "blind-staggers." For many years it was the prevailing opinion here that this disease was caused by feeding worm-eaten or unsound corn, but in 1875 our loss in this and adjoining counties was very serious, and we never had heavier or better corn than in that year. Stock not in use and fed entirely on grass are not liable to contract the disease, and nearly all those attacked would recover if they were turned on grass as soon as the first symptoms appear.

The first symptom of the disease is a disposition to sleep, and a dull, stupid appearance generally. As the disease progresses the animal becomes blind, and the disease soon assumes the form of brain-fever. Some die in twenty-four hours, while others may linger for weeks. I have relieved several by boring through the skull to the brain with a small penknife. They recover their sight immediately and become very docile; but it is evidently a disease of the stomach, and I think much of it is caused by too severe labor when the stomach is full, although it has raged here as an epidemic.

Mr. JOHN ARMSTRONG, Coryell, Coryell county, says:

Having resided on a farm in this county for twenty-two years, and knowing something of diseases among horses here, I will try to answer some of your inquiries. Spanish fever, when I first came here, was the dreaded disease, but I think as soon as horses are acclimated they are less subject to it, and it is also less fatal. Before the war I lost several valuable animals by it. Symptoms: Moping around, or standing still much in one place; very high fever; slightly swollen in the throat; great difficulty in swallowing; inability to lower the head to drink; stiffness in the hind parts and tenderness in the loins; a slight bran-and-water looking discharge from the nostrils. The duration of the disease, which generally terminates in death, is from four to five days; sometimes the animal lingers for several days.

The first animal of mine that recovered was a large Tennessee mare, twelve years old and in fine condition. As soon as I observed the first symptoms of the disease I bled her copiously, and in three hours after she could drink water from a bucket by holding it up to her. In about five hours she ate a wheat-bran mash (one gallon), and in twelve hours had a fine appetite, eating and drinking all I would give her. She was well, but weak from the loss of much blood. She was never sick afterward, and died in colting, at the age of nineteen. Of the second case, a wild, unbroken four-year-old gelding, I bled him till he staggered, put water up for him in a trough, and sheaf-oats, and left him loose in the lot, as he was too wild to drink from a bucket held by a man. He recovered at once from the disease, but, like the mare, shed off his hair until his back and sides were naked. Since then I have lost none. Seeing the remedy at page 39 of the Agricultural Report for 1869, I have used it with entire success, greatly preferring it to bleeding, which weakens so much that the animal is unfit for service for some time after. Many here believe the Spanish fever and the so-called epizootic to be the same. However that may be, animals having green, nutritious grasses or a green wheat-field to run on will not have either disease to hurt them.

Mr. L. N. HALBERT, Bonham, Fannin county, says:

We are not often troubled with diseases of a prevalent character among farm animals, yet now and then we have glanders in horses, a disease which the old Texans denominate "Mexican distemper." When introduced upon a farm or on a range it proves very disastrous, and is beyond cure. I had it in my stock in 1871, and before becoming satisfied as to what it was I used every remedy within my knowledge or that I could hear of. Finally I resorted to what I now believe to be the only remedy—powder and lead. It is much more fatal, does its work more rapidly, and is more to

be dreaded among mules than among horses. I lost some of my best plow-teams, of both mules and horses, before I was able to arrest the disease by a change of stables, lots, &c., and the killing of those afflicted. I have also been greatly annoyed with fistula, a very bad tumor or rising on the withers. I have used many remedies, such as scarring with spirits of turpentine, lancing and putting in arsenic, burnt alum, concentrated lye, &c., but never succeeded in arresting but one case, and that at a very early stage. This I did by burning with a red-hot ring, circling the rising. A sure remedy is to rowel with a red-hot steel spindle through the cartilage of the neck, just missing the blade-bones. This operation never fails to cure.

I ought to have stated, while on the subject of glanders, that the symptoms are, thickness of wind and stupor from three to five days before the nostrils begin to discharge. The discharges frequently begin in the right nostril several days before the left one is affected. The discharges are of a yellowish color, sticky if taken between the fingers, and becoming more abundant and offensive the further the disease progresses in its fatal work. The disease continues until suffocation ends the life of the animal.

CORRESPONDENCE RELATING TO DISEASES OF SHEEP.

ILLINOIS.

Mr. R. H. SAUNDERS, Pecatonica, Winnebago county, says:

Stock has generally been free from disease in this county. There have been reported cases of the so-called hog-cholera this fall, but none have come under my observation. I have nothing to impart with the exception of the fact that my flock of sheep have been infested with parasites for some years past, causing a poorer condition and greater loss than formerly when affected in this way. Tape-worms in the intestines have been numerous, and have proven very fatal to lambs and sometimes to older sheep. Thread-worms in the lungs have also been numerous, as has a stomach thread-worm which resembles the lung-worm, but is rather longer. I think the cause attributable to keeping too many sheep on the same pasture for several years in succession. I have tried many remedies with but little success, and now consider a proper preventive the only protection. First, I change pastures as often as once in two years; plow and cultivate old pastures; do not allow them to drink of stagnant water; give them access to salt mixed with a little sulphate of iron. I have followed this plan for the last year or more, and have greatly reduced the losses. In corresponding with Professor Law, of Cornell University, on this subject, he states that the embryo of the lung-worm is found in the common earth-worm. It would be interesting to ascertain if such is the fact. If so, the cause is apparent, for as land becomes richer from sheep-manure earth-worms become more numerous. Professor Law seems to be uncertain as to how the thread-worm finds its way to the lungs. I will state here that I have found the stomach thread-worm in immense numbers in lambs not more than four months old, but have found no lung-worms until the lambs were seven or eight months old, and have found them most numerous in yearlings. Is it possible that they make their way from the stomach to the lungs?

NEW YORK.

Mr. FRANK D. CURTIS, Charlton, Saratoga county, says:

Sheep are very delicate animals to treat when diseased. They are easily discouraged, and when sick lose their appetite and rapidly become enfeebled. It is by far the wisest course for every shepherd to study carefully the habits of sheep and their nature, and to endeavor, as far as possible, to regulate their diet according to their natural wants, and to do nothing to shock them either by terror or abrupt changes in their management. They will not bear sudden changes of food, sudden chills, or sudden changes of extreme heat and cold. Regularity in feeding and evenness in temperature are essential prerequisites to their healthful condition. They will not endure wet, neither will they thrive on low, marshy ground. The different breeds have somewhat different characteristics, and they are not all alike easily affected with the same diseases, as, for instance, fine-wooled sheep having flatter feet, with closer connection between the hoofs, are more liable to foot-rot than the coarser wooled varieties, with more upright feet and wider space between the bisections. The latter, however, on account of their open and distended nostrils (they have larger lungs and require more space for the circulation of air into the respiratory organs) are much more liable to the attacks of the gadfly (*Œstrus ovis*) than the smaller breeds with more contracted nostrils. The fine-wooled are much more hardy in our changeable American climates than the

coarser wooled breeds, hence precautionary management in regard to climatic influences and carefulness in diet are not so necessary, as they are not so subject to colds and stomach disorders, colics, &c. There are several infectious diseases which prevail among sheep. The two oldest and most common in America are foot-rot and scab. There are also other parasitical disorders which infest the internal organs of sheep. The latter have been far more destructive in foreign countries than in this. They have prevailed disastrously in England, South America, and Australia. We shall speak of internal parasites (*entozoa*) under the head of parasites, with such subdivisions of the subject as apply to the various forms and indications of the disorder as manifested in this country, and of external parasites (*epizoa*) under the appropriate name of scab and ticks.

Parasites.—The most ancient and disastrous of the maladies caused by the development of worms in the body is the *liver-rot*, which is caused by the presence of sucking worms like leeches, which are developed in the liver These worms or flukes possess the power of self-impregnation, and are propagated by eggs, of which they produce immense numbers. These eggs are carried along with the bile into the stomach, and so pass out with the excrement of the sheep. They are supposed to be hatched in stagnant water, in which they develop into a form of mollusks. These soft-bodied mollusks attach themselves to the grass and herbage in low and wet pastures, where it is supposed they are swallowed by the sheep, and the parasites thus get into the stomach, from which they pass into the liver, where they collect in such large numbers as to obstruct its operation and produce this fatal disease. The above theory is not yet fully determined as an explanation of the way in which this internal parasite is produced and developed, but it is certain that sheep affected with the rot will communicate it to others which feed upon the same pasture; hence well sheep should not be allowed to range where diseased ones have been pastured. It is obvious that with the decay of the liver the disease rapidly culminates, and that the symptoms would be marked with fever, an offensive breath, and weakness.

Prevention cannot be applied until there are symptoms of the disease, but when the discovery is made the sheep should be immediately separated from the flock and kept confined in a close field with such others as may show indications of the disorder. It is possible to arrest the disorder in the first stages by a mixture of spirits of turpentine and saltpeter, ginger, carbonate of iron, and salt, according to the following formula: Saltpeter, 1½ ounces; powdered ginger, 1 ounce; carbonate of iron, ½ ounce; spirits of turpentine, 9 ounces; salt, 1 pound, to which should be added three quarts of boiling water, the whole to be thoroughly shaken before being administered. Two ounces at a dose should be given, every fourth day for two weeks. The affected animal should be made to fast for twelve hours before taking the medicine. It is said that hay cut from ground where infected sheep have run will convey these parasites to sheep which may eat it. There is another worm which is developed in the lungs and bronchial tubes of sheep. These worms cause the "pale disease" in lambs, which has been so fatal in many sections of this country. The worm is akin to the gape-worm in chickens, and is a species of *Strongylus*, a slender, thread-like worm. They are supposed to be breathed into the lungs or taken into the mouth while feeding, from whence they make their way through the trachea into the air-passages, in which they produce such derangement in aëration or the purification of the blood as to cause irritation and violent coughing. The important functions of the blood being interrupted, paleness of the skin and debility of the body soon follow, and result in the death of the animal. The disease is more prevalent or fatal among lambs than among sheep.

As soon as a lamb is attacked a poor appetite ensues, which helps to reduce the strength. Such penetrating medicines as turpentine, sulphur, and asafetida may be given, which, through absorption, will reach the lungs, and in the earlier stages of the disease may effect a cure. In order to allow free and full absorption, no food should be given for several hours afterward, nor for a few hours before. Twenty grains of asafetida and a half dram of spirits of turpentine are all that should be administered at one dose to a lamb. One-third more may be given to a full-grown sheep. This may be followed by a tablespoonful of sulphur daily, mixed with molasses. As the appetite is capricious and feeble, in order to keep up the strength gruels should be poured down. The turpentine and asafetida may be mixed with a tablespoonful of linseed or castor oil. Infected sheep should be kept by themselves, and well ones should not be allowed to run in the same pasture, nor upon ground where the manure of diseased sheep has been spread. There are, besides the above, parasites (*hydatids*) or worms in the bladder and in the intestines. The latter, when prevalent among lambs, are fatal. The first symptoms of their prevalence is a falling off in condition and mild diarrhea. The worm is a species of tape-worm, and is swallowed by the sheep in an embryro form, and may have been dropped by a dog or other animal. Emaciation rapidly follows. The excrement is soft and mixed with mucus, and by close observation worms may be observed in it. As soon as the presence of the disease is apparent a dose of turpentine should be given, from one-half to one ounce, according to the size of the sheep. This may be mixed with an ounce or two of linseed or castor oil, and should be given every

three days for two weeks, or until no worms are voided. Nourishing gruels should be given during the time of treatment. The purgative will have better effect if the animal is required to fast a few hours before and after administering the dose. Copperas will not cure the disease. When given in small quantities it acts as an astringent and keeps the worms in the body, and when given in large quantities it is an active poison. The same dose of turpentine and linseed-oil is the best remedy for parasites in the bladder and kidneys.

Worms in the head are not so common in this country as in England, owing to the fact that so large a proportion of our sheep are of the smaller breeds. The gadfly (*Œstrus ovis*) in the summer months deposits its eggs, with a sting, in the nostrils of sheep. At the season of the year when this fly is active, sheep stand huddled together with their noses inward and close to the ground to avoid being stung. After being hatched the grub crawls up the nostrils and feeds on the mucus until it reaches the upper passages, where it remains until it arrives at maturity, and then passes out of the nostrils to the ground, where it ultimately develops into a fly. Sometimes they penetrate to the brain, causing the sheep to lose its appetite and die a lingering and painful death. We have known them to pine away, scarcely eating anything for weeks—simply breathing—until they died of starvation, or were killed to put them out of their misery. There is no remedy except in the first stages of the disease, when the maggots are passing up the nostrils. This may be known by violent shaking of the head, sneezing, and running around. Tobacco-smoke blown up the nostrils at this time, or the smoke of a small quantity of burning sulphur, may cause them to lose their hold on the membranes, when the sheep will cast them out. Some people pour spirits of turpentine into the nostrils. They lay the sheep upon its back so that the liquid will run into the head; but this is a dangerous and cruel practice. In the first stages, in the hands of a skillful person, it is possible to open the passages of the head and remove the maggots, without permanent injury to the animal. Smearing the noses of sheep in July and August with tar, two or three times a week, will, to some extent, prevent the attacks of the gadfly.

Scab.—The worst form of external parasites is the *Acarus scabiei*. This insect is a mite in size and attaches itself to the skin, into which it burrows. It multiplies rapidly and cuts off the connection of the cuticle from its attachments to the body, when it becomes dry and hard, and the wool is loosened and falls out. Its presence can easily be determined, as the sheep is uneasy and inclined to rub itself against any convenient thing. Unless they are destroyed the whole body will soon be covered, causing great distress to the sheep and entire loss of the fleece. They will also be conveyed to other sheep, and eventually spread through the whole flock. One female will produce thousands of insects in a few days. The proper cure is to dip the animal in a solution of sulphur and tobacco, in the proportions of four parts of tobacco and ten of sulphur to a gallon of water. The stems of tobacco will answer every purpose if thoroughly steeped. The sulphur may be stirred in the liquid. Patches of loose skin and wool should be removed before the sheep are immersed. The liquid should be as warm as the hand will bear, and time should be given for it to penetrate every part. After dipping the animal should be left in the yard until dry, when it would be well to smear all the raw and denuded portions of the body with coal-tar, heated sufficiently to flow freely. The coal-tar will assist in healing and protect the sore places, adding very much to the comfort of the sheep.

Sheep-ticks.—These insects (*Melophagus ovinus*) prey upon the surface of the body and torture the sheep greatly by piercing the skin and sucking the blood. It propagates rapidly, and is so voracious that it soon depletes the sheep of needed blood and causes them to become poor and weak. Their presence may be known by the rough, loose, and dangling appearance of the fleece, the locks of which are torn out by rubbing in order to get rid of the pain caused by the bite of the ticks. The most effectual remedy is to dip the sheep in a strong decoction of tobacco. The numbers may also be reduced by dusting snuff or powdered tobacco in the wool. After shearing, the ticks leave the old sheep and fasten to the lambs. The latter should be dipped immediately, and again after the lapse of three weeks. In this way a flock may be rid of ticks, which are a costly and torturing nuisance.

Foot-rot.—This disease is contagious, and may be produced by allowing sheep to run on low, wet ground. It is an ulceration upon the heels and between the toes, which excrete fetid matter. It is most common in the fore feet, and may be known by lameness. Lameness, however, does not always proceed from this cause, but may be produced by foul feet or from inflammation of the interdigital canal, which opens at the bottom of the foot. When this canal or duct is closed by any foreign substance, inflammation will ensue. The prompt removal of the obstacle and the probing and cleansing of the duct will generally effect a cure. When there is ulceration, there must be prompt and effective treatment. Canker of the foot, which shows itself by spongy or fungous sprouts at the bottom, can be cured by the same treatment as for foot-rot. The hoofs should be pared away so as to expose the bottom of the ulcers, when the whole foot, and especially the ulcerous portion, should be thoroughly smeared

with an ointment of powdered blue vitriol, one pound; verdigris, half a pound; linseed-oil, one pint; tar, one quart. This combination makes a salve which will adhere to the foot. Carbolic acid reduced (five parts of water to one of acid) would be an effective remedy, and would also be the best cure for canker of the foot. Healthy sheep should never be allowed in a pasture where those affected with foot-rot have run until a winter's frosts have intervened, which will destroy the virus. Incipient foot-root caused by feeding on wet ground may be checked without difficulty by prompt applications of blue vitriol in liquid form, or by diluted carbolic acid; but when the disease becomes thoroughly ulcerous, several applications of the remedies recommended are necessary to effect a perfect cure.

Constipation.—We have known fatal constipation, accompanied with fever, to prevail in the spring of the year following a long and severe winter, during which fodder became so scarce as to compel farmers to turn out their sheep before the fresh grass had started. The sheep ate of the dry and frost-bitten grass so heartily as to cause it to become clogged in the rumen, producing constipation in whole flocks. In some neighborhoods it was so general that it was supposed a contagious disorder had broken out among them. A number died before the cause was discovered. Purgatives, together with restraining the sheep from feeding in the fields, soon restored the flocks to their normal condition.

Colics.—These troubles are caused by costiveness or flatulence, which also causes stretches (lying on the ground and rolling about), the latter being more of a symptom than a disease. A change of food in this case as well as in the opposite case of scours, is the first thing to be done. Injections of warm water and soap, or linseed-oil, followed with an ounce of the latter or of castor-oil, or four ounces of Epsom salts, given by the mouth, is the first remedy in cases of costiveness or colic. Powdered sulphur and salt should be frequently given as correctives and aids in digestion. Abrupt changes from dry to succulent food are dangerous, and should never be made on an empty stomach, as these animals, like cattle, are equally subject to bloat, and with them it is more rapid in its results. A change from dry feed to green, without an admixture of dry feed following, has produced fatal colic even when the pasture was stinted.

Diarrhea and scours.—The former disorder is very common to lambs while sucking and during the first winter. Unless checked diarrhea will soon run into the more serious condition of scours, and rapidly deplete the tender animal of needed strength. A teaspoonful of laudanum and a tablespoonful of strong ginger tea will often check diarrhea, but if it should not there must be given a tablespoonful of castor-oil, followed by astringents.

Inflammation of the lungs.—Sheep are not apt to be affected with lung diseases, as, under ordinary circumstances, nature has provided them with ample protection, but when exposed they will sometimes have severe inflammation of the lungs. We had a valuable ram die within twenty-four hours with pneumonia, which was caused by being left tied in the wind after having been washed for exhibition at a fair. We have had Leicester sheep which, for a whole year, were afflicted with consumption, and manifested perfect symptoms of this debilitating disorder. Where symptoms of inflammation of the lungs are apparent, the animal should immediately be bled and given a purgative. After this, doses of tartar emetic may be added, one grain to each every few hours, with flax-seed tea. If it is possible a counter-irritation should be made upon the chest. The nostrils must be kept clear and clean.

Snuffles and snoring.—The stoppage of the nostrils with mucous secretions, which may be caused by a slight cold or by dust or some other foreign substance irritating the lining membranes, is of frequent occurrence, but may be obviated by sponging out the nostrils with some soothing lotion. Snoring may be produced by a more serious cause, such as tumors or abscesses in the throat or in the cavity of the chest. When they are discernible they may be treated according to their character. Catarrh is frequent with sheep exposed to the changes of the weather, or when wintered in close and badly ventilated stables. Local treatment, such as sponging the nostrils or inhaling the fumes of burning tar, will usually clean out the nostrils and afford relief.

Poisons.—Sheep will eat almost every plant that grows, which makes them valuable in keeping a farm free from foul stuff. On this account they are often poisoned by eating laurel, Saint John's wort, and other poisonous herbs. The effects are sometimes confined to the stomach, producing a derangement which may be corrected by mild doses of cathartics. The lips and mouth are often made sore by eating poisonous plants, especially Saint John's wort, which sometimes makes the mouth so sore that the sheep cannot eat. In all such cases aperient medicines should be administered, and the lips and mouth dressed with a healing ointment. A change of pasture is also essential to get rid of the cause.

Abortion.—On account of the timid nature of sheep they are easily frightened, and when roughly handled or chased by dogs they are apt to abort. Dysentery and other acute derangements of the stomach will sometimes produce this same disorder, hence abrupt changes in diet should be avoided, and a mixture of dry and green food given

through the winter. Roots are very essential to the good health of sheep. Salt and water should always be accessible, as sheep desire to drink often and but little at a time. If these sanitary recommendations are carefully carried out, sickness among sheep will be very much lessened, especially in the severe forms of abortion or other disturbances of the uterus.

OHIO.

Mr. E. J. HIATT, Chester Hill, Morgan county, says:

Our time has mostly been occupied in breeding sheep. We have made examinations of flocks in Vermont, New York, Pennsylvania, West Virginia, and to a limited extent in Missouri and Massachusetts, and also in our own State. We have found that climate, soil, and lay of land have a great influence in regard to the health of different breeds of sheep. Our experience has been largely with the merino breed, but not entirely so. We consider this section as healthy and well adapted to the successful growing and improvement of the merino as any section we have visited. In this and adjoining counties the diseases of sheep that most prevail are more destructive to young animals—lambs and tegs—from lambing until the first shearing. There is a disease prevailing here in wet seasons which is very generally called "paper skin" or "pale disease." It is probable that a number of distinct and separate diseases, or causes, are here called one disease, and given the above name. Grub in the head, tape-worm, long-worm, stricana or strichnia, and some others are frequently spoken of by the wool-grower as one disease—"paper skin." The lack of a sufficient quantity and proper quality of feed is a great cause or assistant to diseases.

Grub in the head is not a new disease, but it is a very difficult one to prevent or cure, and it is more or less destructive on all kinds of soils and to sheep of all ages. There are two sufficient reasons why the disease is difficult to prevent: First, because the insect or fly that causes the disease eats but little or nothing during its life; and, second, because it deposits in the nostril of the sheep a living grub or larva. The disease is difficult to cure on account of its location. Turpentine and tobacco-liquid are sometimes administered with a syringe or by pouring in at the nose, but with not very good effect. The fly attacks the sheep more generally from the middle of June to September. Great injury is done to large numbers of sheep annually that are not destroyed. It is difficult to determine the per cent. that die, but the actual fatality is not greater than in some other diseases.

Perhaps more deaths occur from tape-worm than from any other disease, especially during wet seasons, when grass is abundant. It sometimes affects lambs at three months old, but does more damage to tegs just after weaning and previous to the appearance of good grass in the spring. Those affected become weak, pale, and do not grow; eat reasonably well, but irregularly; drink abundantly and frequently; in the first stages of the disease seem to lack power more than flesh. It has less effect on grown sheep. Those affected would appear to become wilted or shrunken; the skin becomes very pale and thin; the wool does not separate from the skin as in other diseases. In the last stages the animal lacks blood. Occasionally they die within two or three months, but more generally they live for a longer period. I have doctored for this disease with very good results, having cured nearly all cases that were thoroughly tested. I use pumpkin-seeds, and administer by either feeding in other feed or by making tea. I also feed pumpkins, including the seeds. Information as to the cause of the tape-worm, and a preventive or cure, is greatly needed by the sheep-growers of the country.

We have no knowledge of the cause of the lung-worm—a name given for the want of a better, perhaps. It affects young sheep in a greater degree and to a greater extent than matured animals. The worm is a small white one, and is found in considerable numbers in the lungs, or in the tubes connecting the windpipe with the lungs. The disease is less frequent than either of those named above, but the fatality is greater in comparison with the number affected. The symptoms are weakness, failure to eat, loss of flesh, and a cough. This disease is but little understood by the wool-grower.

Stricana or strichnia is perhaps a very incorrect name for the disease I wish to describe. It is caused by a very small worm, so minute, indeed, that it cannot be seen without the aid of a magnifying glass. It is believed to cause the sheep to pick or bite the wool from its sides, flank, and other parts, until the fleece becomes more or less ragged and wasted. The skin becomes rough and shows symptoms of disease. It is not contagious, but attacks sheep of all ages. It is more damaging in flocks that have been closely bred "in and in" for many years; indeed, this is the case with most diseases. As both a preventive and cure, wood and cob ashes with salt are used with partial success. We have seen sheep in Vermont and Massachusetts badly affected with this disease as well as in our own State.

A disease prevails in some parts of Ohio and Pennsylvania, and probably in some other States, that destroys large numbers of lambs annually. They are sometimes attacked by it at the age of three weeks, but oftener after they are two months old.

The stomach, liver, and gall seem to be the only parts affected. There have been but few cases in this county, and we have no name for the disease. It is supposed by some to be caused by eating a poisonous weed, and by others by overfeeding on grass when too young. Wool is sometimes found in the lamb's stomach. The best and fattest lambs are frequently destroyed by the disease, with but little duration of illness.

Heavy losses are also annually sustained by diarrhea and dysentery. Proper food and management have more to do in preventing and curing these diseases than most others. The treatment and medicine that have been most successful are the same as those used in the human family for like diseases. A statement giving the best remedies and treatment of all these diseases would be received by thousands of sheep-raisers with great profit and many thanks.

Mr. H. H. CUNNINGHAM, Steubenville, Jefferson county, says:

In times past we have had foot-rot, so called, and paper-skin among sheep, and cholera among fowls. Foot-rot to my knowledge has never originated here, but has been introduced by careless handling of sheep brought from other places, where it seems always to exist. The localities in which it develops itself without inoculation are in low marshes or moist grounds, where the feet are always wet or damp. It is unquestionably a disease caused by wet feet, and a cure without removal from the locality that caused it is an impossibility. The proper preventive would be the drainage of all moist soils, and keep the animal from coming in contact with those already diseased. For a cure the removal to dry soil is indispensable, then the paring of the feet and the application of strong caustics, such as blue vitriol, nitric acid, or butter of antimony. This, with close, careful attention for a few months, will usually effect a cure.

As regards "paper-skin," no cure has as yet been discovered (at least I have no knowledge of any). From my own observation I think it could be easily prevented. It is my opinion that the disease is occasioned by deficient nutrition, as it has always occurred in cold, wet seasons, when pastures are constantly wet and either have some of the elements of nutrition washed out of the grasses, or it may be the lack of heat and sunshine fails to develop those qualities. This, in connection with the unfavorable effects of the weather upon the constitution of the animal, is abundant cause for the low and feeble condition that always precedes this disease, or rather this is the disease itself. A supply of grain in such seasons, sufficient to keep up the normal condition of the animal, would, in my judgment, be a sufficient preventive.

Mr. W. B. SHAW, Beverly, Washington county, says:

Lambs in this locality have been scourged for several years past with a disease called "paper-skin," which seems to be worse in wet than in dry seasons. It is not uncommon to lose an entire flock by the disease. It attacks the lambs at the age of from three to five months, and those in good flesh are as liable to it as those that are in poor condition. When attacked, they become very pale and weak, apparently almost entirely bloodless. The stomach contains small red worms, and frequently, in addition, the animal will be found to have tape-worm. I know of no cause or positive cure for the disease. I have tried many remedies, and have found more benefit from feeding pumpkins than from anything else.

Many sheep die with grub in the head. The symptoms are bloody, mattery discharges from the nostrils. Pine-tar placed in their salt-troughs from June until September (during the season the gad-fly deposits its eggs) will be found a preventive. A positive cure will be found in syringing the nostrils with a decoction made from tobacco.

PENNSYLVANIA.

ROBERT VANVOORHIS, importer of thoroughbred and breeder of American merino sheep, Monongahela City, says:

I have been a breeder of American merino sheep for over thirty years. For six years or more the sheep of this vicinity have been afflicted with a disease commonly known as "paper-skin." It has proved very fatal, especially to young sheep, thousands having died annually. It is more prevalent and more fatal to young sheep in August, about the time of weaning. Sheep of my own breeding have never been affected by the disease; but I have lost a great many lambs that I had purchased of others. Those attacked, if they did not die the first fall, were sure to do so the next season. I bought twenty-five ram lambs, which I took extra good care of the first year. Though they did not thrive as well as those of my own breeding, I had hopes that they would escape the disease. Last July I noticed that they began to show symptoms of the malady, and, having a large flock of yearlings, I took out those affected and gave them extra good care. I commenced to feed sulphur and copperas to them, but without any perceptible effect. After five had died I doubled the dose,

giving a tablespoonful of pulverized copperas every other day; but this did not seem to stay the ravages of the disease. I continued this until I had but five left. The dung of those that died last was white with worms, which were from one to four inches in length. After my entire flock of twenty-five had died, I thought if I had commenced with a heavy dose as soon as the first symptoms were observed, I might have saved some of the lambs. In order, therefore, to test the remedy further, I informed some of my neighbors, who gave it a thorough trial, but without success.

I was recently in the eastern part of Ohio, where I found the sheep affected with the same disease. It seems to be as fatal there as it is here. I am in receipt of a letter from Col. J. W. Watts, of Martin's Depot, S. C., who informs me that he has lost a great many sheep from the same disease. I last November visited Vermont, where I also found the same disease prevailing to an alarming extent. The diseased sheep do not lose flesh. They seem to lose blood, however, for in a short time their skin becomes perfectly white. Their eyes also become white, the ears droop, and they are apparently much exhausted. They drink water freely, eat salt, gnaw at boards, and take up whole mouthfuls of dirt, but eat neither grass nor hay. They seem full and in good condition up to the time of their death. When opened no blood is found in their veins, but the stomach and intestines are full of worms, which have collected in bunches or knots.

Various remedies have been tried here, but without any perceptible effect. If the disease is not soon checked, many large dealers and breeders will lose entire flocks of valuable animals.

OREGON.

Mr. Daniel Chapman, La Grange, says:

There is no prevailing disease among domestic animals in this county except that of scab in sheep. This parasitic disease has heretofore prevailed to considerable extent on the Pacific coast, but it is getting to be better understood and is now fast disappearing under close watchfulness and timely remedies. I have had considerable experience with the disease, and have succeeded in exterminating it as follows:

First, I sheared my sheep very close, and peeled off all scabs or sores, and at the time of shearing I spotted every diseased place with a strong wash of corrosive sublimate and water. I then dipped them three times in a strong decoction of tobacco, using one-half pound of stem-tobacco to each sheep. The dip was heated to 120° F., and the sheep held in it at least two minutes. The dipping should be performed at intervals of fourteen days.

After several years of experimenting, I found this a sure remedy. Many other prescriptions were used, but without success. The sheep should be put on fresh pasture after dipping, and not allowed to run on the old one for one year thereafter. Scab is the only disease to which sheep are subject on this coast. Foot-rot and other diseases so prevalent in other localities are entirely unknown in Oregon. There are no prevailing diseases among other animals.

CORRESPONDENCE RELATING TO DISEASES OF FOWLS.

FLORIDA.

Mrs. Mary A. Collins, Mikesville, Columbia county, says:

Sore-head in fowls is a disease quite prevalent, and if neglected is very fatal. It makes its appearance first in rough, thick scales (somewhat resembling warts) about the head. It spreads rapidly, and often puts out the eyes and enters the mouth, after which the fowl soon dies. The disease can almost invariably be cured, if taken in time, by washing the parts affected once or twice a day for a few days with a solution of copperas (green vitriol) and greasing the parts after each washing. I think at least 25 per cent. of the fowls attacked by this disease will die if neglected, while scarcely one will die if properly treated with the above solution. They often recover after losing one eye, and sometimes after losing both.

Pips is a disease caused by the formation of a hard, horny substance on the lower part of the tongue, sometimes even protruding beyond the end of it. The disease is generally not discovered until far advanced, and then only by the peculiar noise the fowl makes. The remedy is to remove the horny substance with a knife, and bathe the tongue with a little salt water. In a few days the fowl will be in its usual health. The removal of this substance from the tongue is the only remedy I have ever known used. I should like to have a less barbarous one.

I have never known cholera to prevail among fowls in this part of Florida.

INDIANA.

Mr. F. D. RUICK, La Grange, La Grange county, says:

During the prevalence of chicken-cholera in this section it is very fatal. Chickens attacked with it will sometimes live a day or two, but generally they will die within a few hours. I have fed a hundred head in the morning, all apparently in good health, and at noon have found half of them dead, and perhaps half of those remaining were staggering around like so many drunken men. The disease is no doubt contagious, and if the chickens affected are not at once separated from the well ones the entire flock will soon be inoculated.

This year I have lost but three chickens from the malady. As soon as I discovered that they were affected I separated them, giving the well ones a fresh coop, and fed them freely with red pepper (capsicum) and sulphur. The result was that I saved the balance of my flock.

The feathers on the breasts of some of the chickens, when first attacked by this disease, become ruffled; the breast hangs down between the legs and appears to be full of water, like one afflicted with the dropsy.

Mrs. L. J. REYMAN, Washington county, says:

Chicken-cholera has prevailed in this neighborhood for years, in a majority of cases proving fatal to the whole flock. Three years ago our fowls had it for the first time, and out of about forty hens and several dozen young chickens (that were hatched late in the season), I had but ten hens and a few chicks left. I tried several remedies, feeding them asafetida, Cayenne pepper, alum, &c., but do not know that they had any effect, as the chickens mostly dropped dead off the roosts in the night, being apparently well the day before.

About two months ago my flock were again attacked with the disease. Only six or eight died. A few of them dropped off the roost dead, and some lingered near two weeks, eating a little, but getting weaker until they died. A few recovered after being sick several days. I used nothing but a little Cayenne in their feed and alum-water by them constantly, mixing their feed with it also. About the same time a tenant on another part of the farm lost about forty large fat hens and some turkeys. She saved about one-fourth of her flock, including the young chicks. I do not know what remedies she used, but I do not think she used any alum. This disease, for the last few years, has had a depressing effect on the market of poultry and eggs in this county, and we are needing a remedy badly.

MAINE.

Mr. T. J. McDANIEL, breeder of standard and fancy poultry, Hollis Centre, says:

The greatest drawback we have in poultry-raising in New England is *roup* (*Cynanche trachealis*), and *canker* or *catarrh* (*Uzœna*). The former is characterized by a difficulty of respiration, particularly at each inspiration, while the expiration is less difficult. The fowl will raise and extend its head at each breath, thereby inducing coughing. This is sensibly increased at night, and will end in suppuration, during which stage it is highly contagious. Fowls so afflicted should be immediately killed or isolated from all others.

The causes of roup are insufficient ventilation or damp roosting-places; food that will induce catharsis, such as potatoes, sour milk, particularly buttermilk, overfeeding with fresh meat, &c. Last fall I got out of corn, and for three days fed boiled potatoes with a little meal; getting out of meal, I fed potatoes alone for three more days. At the end of this time we were visited by a storm of snow and sleet, and nearly every one of my fowls took cold. Several of them choked to death. Finally breathing with most of them became easier, when a purulent offensive discharge became established at the nostrils, and from the mucous membrane of the throat fauces in particular. Knowing the disease had become highly contagious in this stage, I at once separated them. I observed among those I had bred to standard (for fancy points exclusively) that the disease proved fatal in far the greater number of cases. For instance, among my brown Leghorns that were bred for exhibition purposes only, one cockerel had red ear-lobes—as nature designed—and he alone escaped, though confined with the worst cases, which were among and included nearly all the fine-bred birds.

In-breeding is another cause of failure in rearing pure-bred fowls. With common or native breeds it proves less disastrous, though it should never be continued for any length of time with these, as stamina is thereby decreased and the fowls rendered more susceptible of disease. The old adage holds good in the case of roup especially that "an ounce of prevention is worth a pound of cure." However, my advice is to separate the fowls immediately upon discovering the least symptom, such as coughing,

loud breathing, or a "wet beak." Fowls become contaminated much sooner if fed dough, as the dough that adheres to the beak will be picked off by others. The disease will also be communicated by drinking from the same vessel. The germs of the disease will float on the water and soon infect all.

I never knew of a case of roup in a flock that roosted in trees. If a flock (part of whose numbers have the roup) are at liberty, and are fed with corn scattered on the ground, not in the immediate vicinity of their pens, and should drink from a running stream of water, there need be but little to fear even if some of them should contract the disease; yet the affected cases should be separated, their roosting-places thoroughly whitewashed, and all excrement removed. The fumes of burning tar during the night prove quite efficacious, if persisted in three nights in succession. Sulphate of iron (an ounce to one gallon of drinking-water) is the best remedy.

Fowls are most susceptible to diseases during the molting-season, or when the first snow-storms occur. Roup will soon be brought on by roosting in low and damp apartments during the winter months. Farmers who allow their fowls to roost high in their barns are seldom troubled by this malady.

Sulphur and lard rubbed on the heads of young chicks for the purpose of killing lice, though effective in destroying this pest, will soon bring on roup—sore eyes especially. I have had a dozen little chicks moping around with their eyes closed, and if they had not been fed by hand would soon have died of starvation. If roosting-houses become infested with lice, whitewash is the sovereign remedy, for a flock of poultry covered by these pests will, sooner or later, take roup and its concomitant troubles.

MISSOURI.

Mr. J. HARBISON, Charlestown, Clarke county, says:

I have lost some fowls from roup and cholera. Of the two diseases I dread roup the most, as it does not show as unmistakably as the cholera. A fowl with the roup will eat heartily, and to all appearances look well, until the disease will break out among the entire flock. They hardly ever die with it, but they lose their eyes and look so disgusting that I generally cut their heads off as soon as I find them affected with it. In fact, that is my remedy for all diseases, especially cholera. Cholera usually shows itself by the fowl moping around, generally with a full crop, sometimes with nothing in its craw; will not eat, but drink often; the comb and wattles become a dark red—nearly a black color; the discharges at first are a pale green color, then dark green, and sometimes yellow, like the yolk of an uncooked egg. They are generally fat when taken, and seem to die sooner than when in a lean condition. I have sometimes found the fowls with their craws so full of dry grass that it would not pass beyond. By cutting open the craw and taking out this food, washing with warm water and sewing it up again, they will soon get over the disease and in a few days will begin to eat heartily.

Mr. RALPH W. MILLS, Webster Groves, Saint Louis county, says:

My experience with fowls extends through a period of eight consecutive years, prefaced by a familiarity with this portion of the feathered race during boyhood. I have bred successfully, and in the order named, the varieties classed as games—White Crested, White Polish, Light Brahmas, Buff Cochins, White Booted Bantams, Gold Laced Sebrights, Partridge Cochins, Black Breasted Red Game Bantams, Plymouth Rocks, and Silver Spangled Hamburgs—all being of the kind popularly termed "fancy fowls."

As regards diseases affecting fowls coming under my observation, they are chiefly two in number, viz., cholera and roup; and what may prove as great a scourge as either, the plague of lice.

Cholera is in its symptoms not unlike the disease which similarly affects human beings. It is first observed in the character of the droppings, green in color, growing thinner, clearer, and more liquid with each subsequent evacuation, until, utterly weakened and prostrate, in a course of from twelve to forty-eight hours' duration, the fowl succumbs to death. During the attack great thirst is manifested, but indifference to food. I have been unable to learn that any person has ever positively determined the cause of this disease. My own opinion is that it is a generated poison (atmospheric), not unlike malaria, and dependent for its development upon certain favoring conditions in certain localities at certain seasons. It is contagious in some degree; and fowls having the disease should be promptly separated from those not affected, and those dying of it should be carefully buried at once, or burnt with brush or litter, to obviate the danger of infection.

I have but little faith and have had but indifferent success in "doctoring" the disease with anything in the nature of drugs given in doses. Four cases in five will result fatally. Dry, warm, clean, well-ventilated quarters, other than those lately occupied by the sick fowls, a complete change in the food offered and in the order of feeding,

freely incorporating ground red or black pepper in all soft food given, with the "Douglass mixture" put in all the water placed before them to drink, will accomplish, together with an occasional disinfection of their premises by the use of carbolic acid in solution, and fumigation of their houses with roll brimstone and rosin placed on live coals, about all that can be done to cure and eradicate the disease.

Reference is made in this connection to the "Douglas mixture," a tonic in general use among experienced poultrymen everywhere, the formula of which originated with Mr. John Douglas, of the Welesley Aviaries, England. It is as follows: 1 pound sulphate of iron, 1 ounce sulphuric acid, 1 gallon water. Give a teaspoonful in each pint of water placed before the fowls to drink occasionally in health as a preventive; frequently in disease as a corrective. It is inexpensive and very efficacious. Upon the reasonable hypothesis that "prevention is better than cure," the suggestion is made that, so far as they can be known, the *wants* of fowls should be supplied in order to keep them in health. Gravel, lime, grass, vegetable food, insects or animal food, liberty, fresh clean water, regularity in feeding, &c., are all essential to the healthfulness of domestic poultry.

The disease second in order, viz., roup, is well known, and, in its incipiency, can be successfully treated. It is the result of a cold attacking the head; is similar to nasal catarrh in the human species. The disease arises from exposure to uneven and unwholesome temperatures, especially as maintained in the fowl-houses. Dampness here, want of light and ventilation, draughts of air, &c., are fruitful causes of its appearance and favorable to its perpetuation. The symptoms of an attack are, first, a thin, clear, mucous discharge from one or both nostrils, sneezing, and froth in the corners of the eyes. This froth can be seen to bubble when the fowl breathes. As the disease progresses (which it will certainly do if neglected), the discharge becomes more profuse, and changes in color and consistency, becoming decidedly yellow and thick, and eventually putrid—offensive to the sight and to the smell. The whole head becomes involved; the parts swell and become inflamed; the eyes close, and the patient, constantly falling off in condition, becomes helpless and unable to supply its wants, and finally dies. The disease may result fatally in two weeks, and may continue three months. I have cured two obstinate cases; in one of these, however, one eye was entirely lost. I once checked the disease that had attacked at least twenty of my fowls at one time by the timely use of vigorous sanitary measures alone—a thorough cleaning; fumigating (for like cholera it is contagious); changing of feed, &c.; the use of the Douglas mixture in the drinking water, and a thorough cleansing of the parts affected in this disease—eyes, nostrils, mouth, and face—with "Lavrabaque's solution" of chlorinated soda (to be had of any druggist), diluted with an equal part of tepid water, applied with a small piece of sponge. In the instance referred to one application sufficed. In cases more advanced two applications per day, morning and evening, should be made until improvement follows. Warm water and vinegar, in equal parts, are useful cleansing agents instead of the solution mentioned. I have no confidence in the use of internal medicines in this or other diseases affecting poultry, except the "tonic" before mentioned. Change in the fowls' living-quarters, extreme cleanliness, disinfection, and fumigation are the general agencies that are to be employed in disease, so far as my observation goes.

As to the "plague" alluded to in the beginning of my letter (that of lice), in the language of a brother poultryman, "they are simply a disgrace," and perhaps after all, when allowed through neglect to multiply *ad libitum*, become the greatest of all obstacles in the way of successful poultry-raising. It may be set down as a rule that *fowls are never thrifty when infested with lice*. They are out of condition, and therefore especially liable to any of the diseases which infect their species. Prevention in this, as in the case of disease, is better than cure. Clean premises; dust-baths to wallow in; flowers of sulphur in the litter composing the nests; saturation of roosting-poles, or perches, with coal-oil; fumigation; application of hot whitewash to all parts of the fowl-houses, are effectual preventives of this scourge.

If the vermin have already obtained a lodgment upon fowls and in henneries, the same measures much more vigorously employed, in addition to those suggesting themselves as serviceable in improving the general condition of the flock, with the use of flowers of sulphur (a tablespoonful to a quart) in all the soft feed given them for a few days, will banish and destroy the nuisance.

This pest, of which I have definite knowledge, is of two varieties; a large kind, a sixteenth of an inch and over in length, quite in appearance like the genus that attacks squalid and untidy children, not very numerous on a single fowl, but leaving old fowls to prey upon young ones as fast as they appear. This kind is very damaging to little chicks, usually fastening upon the poll, and around the vent, and under the wings. Grease will kill them.

The other variety is far more troublesome in a general way, by reason of their great numbers, swarming in myriads in the places occupied by the poultry, and in places contiguous, literally overrunning the fowls, and almost deterring the keeper from entering the premises devoted to them, for they will get upon one's hands and clothes,

and are so infinitesimally small that they are with difficulty got rid of. This kind will drive a setting hen from her nest, and cause all the fowls to dread their quarters. They multiply to this extent *through neglect.* The remedy has been suggested.

It may be remarked, in concluding, that the care, management, and treatment of fowls, in health and in disease, are essentially the same in the case of the choice, pure breeds in the yards of the "fancier" and mongrels produced by any sort of cross between varieties that are found in numbers upon the farmer's premises. In either instance, any measure adopted with a view to supplying the natural requirements of the creatures will be the most effectual means of improving their condition and enabling them to ward off disease, which in most cases, in my opinion, results from neglect.

NEW YORK.

Mr. Frank D. Curtis, Charlton, Saratoga county, says:

Chicken-cholera has never raged with any degree of violence in this region, and we are not sure that it has ever appeared at all. Chronic dysentery has no doubt been taken for it, from the fact that this disease has stubbornly resisted every form of treatment. Owing to the peculiar formation of the digestive apparatus of fowls, curative remedies for indigestion or bowel complaints are not satisfactory in their operations, and it is exceedingly difficult to administer any medicines which will cure the disorders to which they are subject. We have no faith in any remedy for cholera or dysentery, and on this account shall not prescribe any. The per cent. of cases cured is so small that it will not pay to attempt any medication except where the bird is of rare value. As soon as the type of the disease is determined it is best to kill and bury the subject without delay. Diarrhea may perhaps be checked by confining the fowl and giving it no feed but such as has been mixed with an astringent property, such as tannin, or the tincture of opium. Pepper is a favorite medical tonic with poultry fanciers, and this, with brandy, is good as a warming stimulant, where the fowl is drooping.

Scaly legs.—This is a parasitical disease, and is produced by mites or insects, which burrow under the scales of the legs and eat into them, causing them to become honey-combed and so weak that they will snap off. Before this stage of the disease is reached, however, the legs have become so tender that the fowl will not travel around to gather its food, and soon dies from starvation. Unless destroyed, these mites will infest the whole yard of fowls. An application of carbolic acid, reduced (one drop to five of water), or spirits of turpentine, well soaked in, will destroy them effectually. The legs should be oiled afterward.

Lice.—Lice, of which there are two or three species, are a common pest of hen-roosts. Fumigating with burning sulphur will destroy them, and powdered sulphur or salt grease thoroughly spread on the surface of the body will rid the fowls of these pests.

Roup.—Fowls are very susceptible to colds, which frequently result in the swelling of the glands about the eyes and nostrils, often to such an extent as to produce total blindness. Of course, a fowl in this condition must be fed. We have cured the worst forms of roup by carefully washing the head with alcohol and turpentine mixed, one-third turpentine, two-thirds alcohol. Care should be taken to keep the wash out of the eyes. Sweet oil or fresh butter should be applied immediately afterwards. Two daily applications of the wash are generally sufficient, with a continuous annointing with oil until well. Black comb and wattles, which, if not a disease itself, is an evidence that the fowl is out of condition, may be cured by one application of the above wash. Frozen combs and wattles should be cut off as soon as discovered, and the wound smeared with oil. If left to dry up and slough off, they are painful and debilitating.

OHIO.

Mr. Joseph Love, Bacon, Coshocton county, says:

The principal disease here among poultry is called chicken-cholera. The first thing we observe is a diarrhea. The head becomes pale and the fowl commences to droop and is disinclined to move about. There seems to be fever and thirst, the fowl drinking very often. When the internal parts are examined the liver is much swollen and is dark-colored. When a flock is attacked the greater part of them die. We have found no specific for it yet. We think the exclusive use of corn as food has a tendency to bring on the disease. In my own case I have found that rich bran mixed in dish-water and occasionally in milk makes a healthy feed; so does wheat-screenings. Pure water is very essential. Fowls are not as particular as other animals as to what they drink. They will drink drippings from manure-heaps and other filthy places as greedily as from pure sources. I think cleanliness in all respects would ward off the disease.

Mr. A. G. GARDNER, Rutland, Meigs county, says:

All farm-animals in this locality are comparatively healthy and free from epidemic or prevailing diseases. With fowls, however, the case is quite different. The losses have been heavy, and complaints are heard from every neighborhood of the terrible ravages of what is termed chicken-cholera. Whole henneries have been depopulated. No form of treatment appears to check the progress of the disease. I have never lost a fowl myself, and yet I raise from seventy to one hundred annually. I give my fowls full farm range, change my cocks each year by getting eggs from the best possible breeds, and select the best formed stock from these. They have high out-door roosting-places most of the season, but in cold, winter weather I confine them in warm, clean, well-ventilated roosts.

Mr. AMOS WOODLING, Beach City, Stark county, says:

Heavy losses have been sustained among fowls by the ravages of a disease called chicken-cholera. Entire flocks have been destroyed by it. The fowl becomes stupid, loses its general brightness about the head, diarrhea sets in, and the result is death within three or four days. After death the liver is found to be of a light clay color.

Mr. C. J. C. BOYNTON, Pulaski, Williams county, says:

For a number of years past we have been troubled with a disease known here as chicken-cholera. Three years ago this fall I had 150 head of pure-breed and half-breed Light Brahmas. They were attacked with this disease, and in about a month or six weeks I lost over 100 head. When first attacked the head of the fowl would turn purple, and it would begin to droop and mope about. In a little while diarrhea would set in, and the excrements would be of a greenish color. The fowls lived but a short time after the first symptoms showed themselves; some would die in a very few hours, while others would linger for a day or so. Since that time the disease has visited the flocks of about all my neighbors and with about as fatal results. We have found no sure remedy for the disease. We tried indigo in the water they drank, a solution of white-oak bark, and many other things, but without apparent benefit.

PENNSYLVANIA.

Mr. E. BURKET, Arch Springs, Blair county, says:

There have been very fatal diseases prevailing among fowls in this locality for some years past. I have known many flocks to nearly all die, and some of them were composed of perhaps one hundred and fifty head. During the fall I lost ninety head myself. The disease seems to prevail at any season. We have found cayenne pepper, mixed with corn-meal, about as good a remedy as any. There are many other remedies used, such as alum-water, asafetida, red pepper, &c. There was no disease among fowls here until the foreign varieties were brought into this locality.

Mr. A. M. DICKIE, Doylestown, Franklin county, says:

I have given some little attention to the ailments of fowls, as I keep a few and am interested in them. The diseases incident to the poultry-yard are very little understood, and the result is enormous aggregate losses every year. In the general investigation and study of the diseases of farm-stock, veterinary science has, so far, ignored or omitted to study the ailments of poultry, mainly, perhaps, from the fact that poultry are looked upon as inferior, or subsidiary farm-stock, and of little or no account anyhow. This is a misapprehension, because the poultry interest is really an important one, susceptible of almost indefinite expansion and usefulness.

The hinderances to poultry-keeping may be arranged in three classes: 1. Parasitic diseases. 2. Catarrhal diseases. 3. Poultry cholera.

In the first of these classes, the main trouble is the gape disease, produced by a parasitic worm in the trachea of young chickens and turkeys.

In the second class the principal disease is roup. This is common to all ages, and prevails mostly from November to May, and is much more prevalent north of the fortieth parallel than south of it. I think there are at least four distinct diseases included in the general term roup.

The prevailing disease in poultry in the summer months, or from May to November, is poultry cholera. This is much the most serious and fatal of the hinderances, and has discouraged many poultry-keepers south of the fortieth parallel, as it is mainly developed south of this line.

These diseases are all epidemic in character. They extend over large sections, are very destructive, and in some localities have greatly discouraged people to the detriment of the interest in poultry production.

If poultry-keepers knew how to manage or control these three classes of ailments, most of the hinderances would be overcome. Any investigation which will tend to

remove or overcome them will be gladly accepted by the people as a needed assistance in protecting an important and growing industry.

The general public has no appreciation of the importance and value of the poultry industry in our country, and especially on the North Atlantic slope and Lower Lake region. The annual products of the poultry-yards of the nation are variously estimated at from $200,000,000 to $450,000,000. The truth is probably between these extreme figures.

The annual poultry products of Bucks county are very near $2,000,000, and amount to more in value than any other industry pursued in the county as a specialty. It leads the dairy interest, the grain interest, the fruit interest, and all other kinds of live stock put together. But this is probably the leading county in the Union in poultry production. There is nothing to hinder the business being generally extended, except the drawback resulting from ignorance of the management and the prevailing diseases.

Mr. J. JAMESON, Greene county, says:

Chicken-cholera seems to be permanently located here. It has not been so prevalent, however, the past year as previously. Remedies are numerous but not very satisfactory. So far as personal observation goes, I think calomel is used as a remedy with better success than anything else.

TEXAS.

Mr. J. E. GRAY, Brenham, Washington county, says:

A fatal disease commonly called cholera exists among fowls here. The symptoms are first a drooping appearance and disposition to remain on the roost until late in the morning; indifference about food; the wings droop or fall; great thirst, as they drink frequently. Sometimes they show signs of gapes. These symptoms continue from two to three days, when death ensues. When the disease strikes a flock it carries off from 50 to 80 per cent. This season one flock of seventy had but seven left. My wife has used the following remedies with apparent success, but more as a preventive than a cure, viz., red pepper, sulphur, alum, copperas, turpentine, or rosin, with lime-water to drink. I dissected one that died suddenly, and found the liver in almost a state of decomposition. This leads me to the belief that the liver is greatly implicated in this disease.

Mr. J. H. IKELER, Millville, Columbia county, says:

Heavy losses have been sustained here by a disease known as cholera among chickens and other domestic fowls. Almost every farmer and chicken-breeder in the county has suffered to the extent of almost his entire flock. It has prevailed here for the last eight years. On its first visitation to my flock (six years ago) I lost over one hundred head in three weeks. When attacked with the disease the comb and gills of the fowl turn a pale whitish color, and it seems stiff and helpless; it refuses to eat, and its excrements are of a thin, yellow, greenish color. They generally die within from twelve to thirty-six hours. A great many remedies have been tried, but without any beneficial results.

Mr. R. L. HIGHTOWER, Elysian Fields, Harrison county, says:

Within the past twelve years a disease has appeared among our fowls, which is of a very malignant character, and very fatal in its results. It made its first general appearance in 1867-'68, and has prevailed every year since. It prevails upon farms that apparently have no more local causes for now producing this or any other disease than they did years ago, and before the disease made its appearance. My farm, for instance, was opened in 1838. I kept fowls upon it all the time, and had no disease among them until 1868—thirty years. There were no changed conditions about the place that I am aware of to produce the disease.

It has occurred to me that the disease is of atmospheric origin; that it is carried in a wave, like the epizootic in horses. Yet the entire escape of fowls on some farms, while on all others around it they are affected, rather overturns this theory. The disease generally makes its appearance in the latter part of spring and in early summer. In one or two instances it has delayed its appearance to the latter part of summer. The fowls are generally attacked suddenly, and when in apparent perfect health. Some go to roost at night in apparently good health, and the next morning are found lying dead under the roost. With others the disease is more protracted. They droop; the combs turn pale; the feathers look dead, and loosen and drop from their bodies; discharges, sometimes copious and at others small and pale, indicating non-action of the liver: great thirst, indicating high fever. Some live but for three or four days, and others from ten to fifteen. The times have been prolific of so-called remedies. We have tried nearly all we have heard of, and have found calomel the most effectual

of anything we have used. The result of our experiments with a tea made of the boiled cones of the "Jamestown weed" causes us to believe *that* to be a good remedy. Nothing except the above two remedies have ever seemed to us to produce any good effect. We give the tea as a drink, and also moisten the meal that we feed to them with it. I think a tonic is a good secondary remedy, such as pepper, to relieve prostration produced by the disease.

CORRESPONDENCE RELATING TO DISEASES OF THE VARIOUS CLASSES OF DOMESTIC ANIMALS.

ALABAMA.

Mr. W. P. Cooper, Alexandria, Calhoun county, says:

The disease affecting horses in this locality for the most part is simply colic, caused by overwork and irregular feeding. All horses are more or less affected with bots, but they seldom attack until disturbed by an accumulation of gases. To prevent colic, moderate work, regular feed, and a proper amount of green food are necessary. If the physical condition of the horse is reduced, disease will surely follow. As a remedy for colic, one ounce of chloroform to three ounces of sweet milk and one pint of whisky, mixed with one pint of water, and used as a drench at the mouth, will cure ninety-nine cases out of one hundred. As a remedy for bots, drench with one quart of lard-oil. If not relieved in thirty minutes, repeat the dose. I have seen the bot die almost immediately when dropped in hog's lard. The grub breathes through the pores of the body, and when oiled they cease to breathe and death ensues. Nitric acid will not kill them, but oil will.

Native cattle here are subject to but few diseases, but imported cattle almost all die of a disease we call murrain. But few live to become acclimated. The symptoms are eyes feverish and excited; disposition to stand in water; very thirsty; discharges of bloody urine. In two or three hours the animal becomes uncontrollable and dies suddenly. On *post-mortem* examination one portion of the stomach is found perfectly dry. There is also found a large extended gall or bladder filled with bloody secretions. In the region of the heart are found collections of fluid which seems to be an overflow of bile from the gall. The disease is very fatal. We have no remedy.

Cholera is the only disease which seems fatal among hogs. When attacked the hog becomes stupid, its eyes matter, and it is often stiff and lame. Sometimes the animal is constipated and at others exactly the reverse. As a preventive, sulphur, copperas, salt, and strong wood-ashes in equal parts, mixed in slops, is given once a week. Cabbage leaves are regarded as an excellent food for sick hogs, and many believe them to be a cure for the so-called cholera.

Mr. L. B. Thornton, Tuscumbia, Colbert county, says:

Horses here are subject to several different diseases, such as spavin, fistula, blind-staggers, glanders, &c. The best remedy for glanders is to shoot the animal as soon as taken, for the disease is incurable. Feeding horses on more oats and fodder and less corn will be found a preventive for many of the diseases which afflict them, and will also keep them in good condition.

Cattle are subject to murrain, and in both cases the disease proves fatal. Good pasturage and regular salting are also good preventives of diseases among cattle. Common colic in horses and cattle is generally cured by carbonate of lime, a teacupful in a pint of water and used as a drench.

For bots in horses I have found the best remedy to be a strong sage-tea, with molasses.

Hogs are afflicted here with a disease called cholera, for which no remedy has as yet been found. Calomel is extensively given. My experience leads me to believe that if hogs have plenty of good water, and are salted regularly and given sulphur and ashes and a supply of bituminous coal occasionally, they will escape many of the diseases to which they are subject. A great many of the diseases which afflict swine are caused by worms and lice. I used grease and tar for lice and calomel for worms, with good results. Last year, when the hogs were dying here by scores, I kept mine up in pens, with plank floors a little elevated. I kept the pens clean and used coal-oil and sulphur to destroy the lice. I kept a constant supply of wood-ashes and coal in the pens, and during the prevalence of the disease I did not lose a hog. They thrived and fattened well, and contained no intestinal worms when killed.

Fowls are subject to chicken-cholera, which is seldom cured. My experience is that if fowls are kept in clean, well-ventilated houses, and given sulphur and lime to keep off vermin, and are fed well, they will remain exempt from disease. Care and atten-

tion to feeding well are indispensable to healthfulness in fowls as well as all kinds of farm-animals.

Mr. IRA R. FOSTER, Gadsden, Etowah county, says:

Horses are afflicted with numerous diseases, the most alarming and fatal of which are "bots" and colic. The former manifests itself suddenly and produces great agony, which frequently results in the death of the animal in a few hours, occasionally in a few minutes, and upon a *post-mortem* examination the coats of the stomach are found partially destroyed by the worms or grub. The symptoms are a disposition to frequently lie down, stretching the head and neck on the ground, drawing up the top lip and showing the teeth plainly, casting the head back behind the fore legs with nose to the body, excessive perspiration, but no swelling of the body. The symptoms of colic are pretty much the same, and the two diseases are often confounded; but in the latter the body is almost invariably more or less distended, and not unfrequently to an alarming extent. We have no reliable remedy for the bots in cases where the animal is violently attacked. The main hope against its deadly ravages is by means of preventives. The colic is more manageable, generally yielding to large doses of carminatives and anti-spasmodics and purgatives combined, such as cloves, pepper, &c., laudanum, paregoric, ether, &c., and salts, castor-oil, turpentine, &c. A slug of moistened tobacco inserted in the rectum is worthy of trial. By regular feeding, watering, and exercise the disease would be less frequent. Of horses violently attacked by bots, 50 per cent. die in less than twenty-four hours. Not more than 5 per cent. die of colic.

Distemper, bloody murrain, hollow-horn, and hollow-tail are the diseases which mostly afflict cattle. The first-named manifests itself in and about the head by the issuance of feculent and corroding pus from the nostrils and eyes, with loss of appetite, attended with great lassitude and exhaustion. I have found mercurial purgatives, aided by salts, the most satisfactory remedy. This disease is not so malignant and fatal as in former years. The murrain is common and fatal. It is manifested by a discharge of bloody urine, loss of appetite, constipation of the bowels, fever and thirst, lassitude, and a general drawing up of the body. No favorable remedy has been presented. Cooling cathartics combined with diuretics and diaphoretics have been tried with partial good results. At least 50 per cent. die when violently attacked, and generally within one or two days. Hollow-horn is common, though not necessarily fatal. It shows itself in cold horns and languid looks, loss of appetite, indisposition to move about, seeming great shrinkage in size of body. If neglected, the animal will die from exhaustion in six or eight days. The disease generally gives way after boring with a large gimlet into the center of the horn (which is usually found hollow) and injecting vinegar, table salt, and black pepper daily for several days; also bathing the horn near the head with spirits of turpentine. The hollow-tail is easily detected by manipulating the tail from root to tip. A portion of the bone will be found destroyed by absorption, say from three to ten inches in length. Make an incision to the center of the tail where the bone is missing, and insert a liberal quantity of black pepper and salt. Then close up this orifice and bandage well, and the animal will soon recover.

Cholera is the main disease afflicting hogs. It is common and emphatically fatal, often killing by the hundreds within a few days. On its first appearance it generally selects the best and fattest hogs for its victims. Although many remedies have been tried, and some with apparent success, none seem to be at all reliable. A sure remedy would save millions of dollars annually. A remedy for this disease we need above all others. If found, the farmers could and would advance in prosperity by raising hogs for market as well as for home consumption. If your department can give to the country that remedy, you will have done a great work—one so great, indeed, that its merits and bounds cannot be measured.

Sheep, when in large flocks and closely penned, die by the hundreds of the various diseases which afflict this class of animals. Small flocks in open and broad pastures thrive, and would be remunerative if it were not for the lean and hungry dogs. The rearing of sheep is sadly neglected at the South.

The cholera among chickens is most insidious, and its causes less understood, and it perhaps proves more fatal than all other diseases combined. A great many die with gapes. This disease is caused by nits and mites, which is the result of uncleanly and improperly ventilated quarters. A great many remedies have been tried. A very simple one is to rub the fowl with kerosene oil, and put one or two drops down its throat. This will generally destroy the vermin. The better plan is to keep clean houses, as prevention will be found worth a pound of cure. This is applicable to all classes of farm-animals.

Mr. W. J. EUBANK, Birmingham, Jefferson county, says:

There have been no diseases prevalent here among horses since the epizootic influenza, which is still fresh in the minds of the people of the whole country. They occasionally die with colic, inflammation of the lungs, inflammation of the bowels, &c.; but as there are no veterinary surgeons here, little is known of the causes of these dis-

eases. Cattle occasionally die without murrain. Goats are almost free from disease. Occasionally numbers of a flock will die with a malady little known here. They are generally attacked with a fit. When apparently healthy they will sometimes begin turning around, which they will continue until tired out, and then fall down. They may get up soon and stagger about a day or two and die. Sometimes they will lie around three or four days, apparently unable to get on their feet. Now and then one will recover without treatment.

Hogs are afflicted with cholera and quinsy. In the dry weather, during summer and fall, when they are obliged to lie in dust, pigs and young hogs are frequently attacked with a disease that has only been known here some three or four years. Little pimples make their appearance on the body similar to small-pox sores. The skin under the body and inner part of the legs reddens, the nostrils swell, and the patient dies within from three to ten days. I could learn nothing from a *post-mortem* examination. The lungs and intestines appeared natural. The disease is confined solely to pigs and young hogs.

Poultry sometimes have cholera and roup. The former I know nothing of, but the latter frequently occurs in cool, damp weather in spring. The head swells, the nostrils and eyes inflame, and discharge a viscid mucus. The nostrils should be syringed with a solution of carbolic acid or nitrate of silver, and sulphur given internally in feed. Where stock are well cared for and supplied with a variety of food and plenty of salt, they rarely ever suffer from any disease.

ARKANSAS.

Mr. J. M. PETTIGREW, Charleston, Franklin county, says:

There are but two diseases that prevail fatally to any very considerable extent among domestic animals in this county, to-wit, the hog and chicken cholera. In this locality the hog-cholera seems to embrace several diseases; and its diagnosis is various. In some instances the hogs have a slow and continuous fever; they become sluggish and seem loath to move; the hair becomes of a reddish color; they have no appetite. In this drooping condition they gradually grow weaker and weaker until they die, but few recovering. In some cases the first symptom is stiffness in the limbs and joints of the hogs; they move as if they were severely foundered. Soon the skin becomes ulcerated over the body, and about the joints and nose boils will break out, emitting an offensive purulent matter. Fever accompanies these symptoms. This type of the disease is very fatal. What few hogs recover shed off most of the hair.

In other instances the lungs and throat seem to be the seat of the disease. The throat and chest become swollen and the animal is afflicted with a cough and difficulty in breathing. These symptoms are attended with fever, and prove fatal in a great majority of cases.

The foregoing are the prevailing types of the disease known here as hog-cholera. By whatever type of the disease the hogs are attacked the same type prevails throughout the entire herd.

No certain remedy has been found. Copperas and blue vitriol are the most successful remedies used here. They are more valuable as a preventive, however, than as a cure. After the hogs have been attacked no remedy has been found to cure any considerable number of them. A variety of food seems among the best of the preventives. During the past summer and fall I fed my hogs copiously on peaches and apples as they fell from the trees, and they have been entirely exempt from cholera and other diseases, while my neighbors' hogs not so fed have died at a fearful rate. Suds from common lye-soap, used for washing purposes, have proved very beneficial in keeping hogs in a healthy condition.

The cholera has killed quite a large per cent. of the hogs in this county during the past summer and fall, and in some neighborhoods it is still prevailing.

Chicken-cholera has also extensively prevailed in this county, and has been quite fatal. The symptoms of attack are drowsiness, the gills and comb become of a purple color, and the evacuations are white and watery. The liver becomes wonderfully enlarged and of a paler color than the liver of a healthy fowl. In most instances the fowl becomes exceedingly fat. Here the disease prevails among chickens, turkeys, and guineas. The most successful treatment for the malady is mercury in some form. I have known that treatment in some instances to prove very successful. The most successful preventives are cleanliness of the hennery, the sprinkling of lime over the floor, and the washing of the walls with lime-water. They should have pure water to drink, in which copperas should occasionally be put. Wild turkeys, even when domesticated, seem exempt from the disease.

Mr. WILLIAM F. WATKINS, La Crosse, Izard county, says:

There never has been any scientific investigation in this county into the diseases of animals or fowls, and all the remedies used have been entirely empirical. I am not aware

of any epidemic ever prevailing here among either horses or sheep. Our greatest losses are in hogs, which for many years have been (in different localities and at different times) subject to great fatality. The disease or diseases are confined to no particular season of the year, but rage only in certain localities at the same time. One locality of even a few miles in extent may suffer one season and be entirely exempt the next, while a neighboring locality is suffering. In a mountain district in the adjoining county of Stone, last summer, nearly all the hogs died. One farmer, by way of experiment, gave his hogs strychnia, both as a remedy and as a preventive, and lost but a small per cent. of them. Chickens and turkeys are attacked locally, just as hogs, but not in the same districts at the same time that hogs are. I have known calomel given to fowls as a remedy with very satisfactory results.

There has been a disease called the black-tongue among cattle in this county, which has only appeared at intervals of several years, and always in the heat of summer. It extends over the whole country, attacks only a small per cent. of cattle, but kills 50 per cent. of those attacked. It is more general and fatal to the wild deer than to cattle. It has not appeared for some years past.

Mr. W. B. FLIPPEN, Yellville, Marion county, says:

Our horses are afflicted with no other diseases than distemper and blind-staggers. Farmers attribute the latter to feeding new ground corn or late corn, which is generally worm-eaten. Others attribute it to the horses eating unsound corn and worm-dust. I know of no certain remedy.

Cattle are occasionally affected with murrain, and what is here called black-tongue. The tongue becomes red and raw on the upper side, and if not attended to promptly, turns brown or black on top, cracks open, and becomes so sore that the animal cannot feed, and in a short time will die. This disease prevails only at intervals. It is easily cured by washing the tongue two or three times with a solution of salt and copperas. I suppose the copperas alone would effect a cure, as those herds are never affected with it where copperas is mixed with their salt in the summer and fall months.

Cattle are also occasionally affected with what is here called Texas fever, but it is not incident to this locality, and prevails only along the line or route where droves of cattle from Texas have passed. The disease is very fatal, and I know of no remedy.

I have observed in this locality, twice within a period of forty years, a disease called "mad itch." I have never known a case cured. At first the animal appears feverish and not inclined to feed. In a day or two the eyes assume a reddish color, and the jaws, or skin on the sides of the jaws, become much swollen. When opened with a knife yellow water drops out freely. The animal commences rubbing the sides of its jaws against a tree, or anything it can get access to, and will continue to rub until both sides of the head are raw. In two or three days death ensues. Before it dies it becomes to all appearances perfectly mad and furious, but continues to rub its jaws until death relieves it of its sufferings.

Mr. R. H. LEE, Duvall's Bluff, Prairie county, says:

The principal diseases affecting cattle in this county are known as dry and bloody murrain. Dry murrain, which is supposed to be caused by insufficient supply of water is cured by large doses of calomel. There are many other remedies for it. We have no successful remedy for bloody murrain, and very few animals attacked by it recover.

Horses are seldom affected with diseases, but last summer a neighbor lost five head with a malady previously unknown here. The animals were taken with a limping in the fore-legs, but recovered from this in a few hours, when a high fever set in. The horses did not lose their appetites, but took feed liberally. Every case, and there were a good many in the neighborhood, proved fatal within from three to five days. Many different prescriptions were given, but they all failed to give relief. The animals did not appear to be much distressed at any time. They generally died very suddenly and without a struggle.

Fowls have what is called chicken-cholera, a disease which is almost invariably fatal. The liver is generally found to be very much enlarged. I have tried calomel, quinine, rhubarb, cayenne pepper, copperas, sulphur, and indeed almost everything else, without success.

COLORADO.

Mr. WILLIAM T. HOLT, Colorado Springs, El Paso county, says:

As to diseases of domestic animals in this State, I reply briefly that cattle here are pretty uniformly healthy. Out of a herd of over four thousand, owned by myself, I have not lost half a dozen head from sickness in the past four years.

There is, however, a poisonous plant growing here, and fast extending over the best stock-grazing portions of the State, which kills annually a good many horses, and threatens to put an end to the breeding of horses here at no distant day, unless some

efficient antidote be speedily found. Already there are large areas of what was a few years ago the best grazing portions of the State (in the counties of El Paso, Bent, and Elbert) where it is now unsafe to turn out a horse or mule at any season of the year, and almost sure death to the animal to do so in winter when the grasses are brown and dry and this poisonous weed brilliantly green in color and full of juice. It is known here among ranchmen as the "loco weed," so named, I think, because its first effect when eaten is to make the animal crazy. Thousands of dollars' worth of horses are ruined every year in this State from the effects of this poisonous plant. It has not, so far, killed many cattle, for the reason that, owing to the vast numbers of this class of animals, it is rarely that any one of the number gets sufficient to kill him, and being apparently less susceptible to its peculiar influence than horses. It has been observed that the more valuable a horse is, *i. e.*, the more highly organized, the less "loco" it takes to intoxicate and finally kill him. No antidote has yet been discovered, and if you can set on foot an investigation which will result in determining a sure cure for a "locoed" horse, you will confer a great benefit upon the stock-growing interests of this community. While this weed has not yet spread abundantly enough to kill many cattle, it is believed to be only a question of time when it will do so, if not checked. The use of horses being indispensable to cattle-raising on the plains, this noxious weed indirectly imposes a heavy loss upon the cattle-grower. It also affects our rams, sometimes killing them outright, but oftener rendering them emaciated, crazy, and useless, but this far less frequently than in the case of horses.

The only diseases to which sheep are liable here are scab and "sore mouth," this last, so far as I know, affecting only lambs before weaning. Out of a flock of ten thousand sheep, owned by myself, these are the only diseases I have had to contend with, and I have found both easily curable. The cause of the sore mouth is not known here. It is not a general but rather a local and rare disease, and never fatal if properly treated. I have never seen it until this summer, when some 1,200 of my lambs had it. The lips are first covered with "chaps," followed by pustules which grow thick scabs. These extend gradually over the thin skin about the mouth and into the nose, making the face extremely sore and feverish, and prevent the lambs from nursing well or grazing. I had the pustules and the scabs scraped off clean and a solution of carbolic acid applied with a brush, which effectually cured it.

FLORIDA.

Dr. JOHN M. MCGEHEE, Milton, Santa Rosa county, says:

I know of no diseases affecting horses in this section which do not prevail in other localities generally, and I will only mention some remedies which are new, so far as I know, and some circumstances connected with those diseases not generally noticed. The greatest fatality seems to result from colic, and a new remedy, which has been used in this section of the South when all other remedies have failed, has been to perforate the walls of the abdominal cavity at a point just half way between the prominence made by the hip-bone and the ribs. This remedy, however, has been recommended by some modern works on farriery. While on this subject I will here mention that before the war, on some large cotton plantations, I noticed that nearly all of the mules and horses which died of colic died on Monday, a very few on Tuesday, and a still less number on other days of the week. These facts I think point clearly to a cause and a remedy. The animals being worked all the week in warm weather, their exercise brings about a certain degree of digestion and appetite. For lack of exercise on Sunday their digestion is weakened, and in most instances colic is the result on Monday. It is plain that the remedy for this is to reduce the feed on Saturday night and Sunday.

The next most fatal and common disease affecting horses in this section is that known here as "blind-staggers." It is first discovered by some foolish or unaccountable act of the animal, and as it advances the intelligence and control of the muscular functions become more clearly affected, until the animal seems to be frenzied. Death generally ensues within from twenty-four to sixty hours. Examination of the brain shows extensive inflammation and serous effusion. The only remedies in this disease in popular use, which are relied on, seem to be herculean and to some extent empirical. The first remedy which I will mention is to bleed profusely on the discovery of the first symptoms of the disease, and then give a dose of spirits of camphor, spirits of turpentine, and tincture of asafetida, and whisky. All of this seems very contradictory, but it is confidently relied on by many who have witnessed its effects. I saw it tried once in an advanced stage of the disease—too late for any remedy to do any good—but in two or three minutes perspiration poured out from every pore. I think if there is any good in this dose it is owing to the almost caustic and destructive effect of turpentine on the flesh of the brute creation. I know that bleeding alone will not arrest the disease. The other remedy is to take two switches, sharpen and introduce them through the nostrils in the region of the brain, then give them a thrust and pull them out,

when the blood is said to flow freely, and if used in time the horse recovers. I heard one man say that he once tried the remedy, and the horse fell as dead as if his brains had been shot through with a ball. The preventives are simple and sure. They are simply sound food. I know that damaged grain will produce it, even if the damage is so slight as not to be readily discovered, as new-ground corn often is, or shipped corn, slightly heated from incipient fermentation, or late corn affected with smut. My experience on these points is full. In 1836 I lived in Montgomery County, Alabama. The corn and cotton crop that year was a failure. Most persons got their corn from New Orleans, which had been shipped down the Mississippi River in flat-boats. The corn generally looked well, and when planted came up, but much of it was damaged and great numbers of horses died of "staggers." I was a boy then, and I heard it attributed to the shipped corn; and I have never *known* a case of "staggers" which I could not trace to some of the above-mentioned causes. A few years ago I sold some corn to two log-men for the use of their oxen. They had one horse each, and both were valuable animals. I knew the corn had been heated, and in the most urgent manner cautioned them against giving it to their horses. But they fed their animals with it, and both horses died of "staggers." Some pastures at certain times are said to produce the disease. In such cases it would seem that it is caused by a web on the grass.

The following remarks on the treatment of horses will perhaps be new to many: About twenty-three years ago I had a horse very badly foundered. I tried various remedies of empirics, but my horse grew worse. After witnessing his sufferings for several days I resolved to know what the founder was (having a contempt for such works on farriery as I had then seen). I prepared to cut into and lay off the whole of the thin covering of the bottom of the foot. Setting my knife obliquely to avoid puncturing the capillaries as much as possible, I introduced it at a point between the frog of the foot and the toe. As soon as I punctured the thin horny covering a serous-looking fluid was emitted. I extended the incision far enough to examine the integument underneath this covering. I discovered the mucous covering of the capillaries entirely separated from the horny portion of the foot. The vascular portion of the foot was highly inflamed and as sensitive as an exposed nerve. I then cut into the other foot and let out this serum. It seemed to me to be analogous to an ordinary blister on the skin, where the cuticle is lifted up and leaves the mucous coat or serum intervening. This serum showed no disposition to harden on exposure to the air and stop up the orifice, but continued to be as limpid as oil of turpentine. He was a long time recovering, but when he did recover the cure was radical. The foot was not the least affected. After he passed out of my possession I continued to inquire after his welfare. He never foundered again or complained of his foot. Had this lymph remained in the foot it would have formed a fungous substance, which would eventually have produced what is known as chronic founder. This operation should never be performed until several days after the founder is known to have caused this effusion. The incision should not be large, and should be made very oblique in order to cover the integument. After the inflammation had entirely subsided the exposed parts were very tender, and I had thin, solid shoes put on, which covered the entire bottom of his feet, and he traveled without any difficulty.

I have had several horses foundered since, and I never found any difficulty in curing them in twenty-four hours by fastening around their ankles cloth or rags and pouring warm water on the bandages. I have generally carried it so far as to produce blistering of the ankles, which has sometimes been slow in curing up. This remedy should be applied as soon as the founder is discovered, and before the formation of the serous discharge. In no case should the horse be used for several days. I believe that oil of turpentine would answer the desired end if used on the ankle after several hours' use of the warm bath, applying after the hair is wiped dry.

I have observed in horses a very marked tendency to metastasis when diseased. This peculiarity may account for their susceptibility to the action of counter-irritants.

All other agricultural interests sink into littleness when compared with cattle-raising. In the Gulf and South Atlantic coast it is blended with our hygiene and civilization, and yet it is hard to find an example of any interest so much neglected.

That you may be enabled to form a correct opinion of the losses of the cattle interest in this section, I will give you the system of stock-raising here. About the 1st of February each year much of the grass-range is burned off, and all the young and tender shrubs which grew up the previous summer are killed by the fire. The wire-grass first starts to grow and puts forth large bunches of young, tender, and quite nutritious growth. This burning is done only in small spots of a few miles square. The cattle soon find it out and gather on "the burn." This burning is done to draw the cattle from the low lands, for at this season they are very poor and weak, and hardly able to get out of the smallest bog. The weather is generally such that, if there is much rain, the cattle catch cold if they lie down at night. Many become stiff and lame, and some are never again able to rise to their feet. If they are lifted up they are so far exhausted that they rarely recover. The remainder of the loss is in boggy branches,

where the cattle reach after a little green switch-cane. These losses frequently amount to 80 per cent. of the breeding cows and a much smaller per cent. of the dry cattle; but as the heifers are rarely ever sold or killed for beef, the stock is thus replenished. If, from accident or otherwise, fires get started and the woods are burned while the weather is too cold for the grass to grow fast, many cows gather on "the burn" and perish while nibbling at the short herbage. This short grass is very weakening to them, as it inclines them to scours.

The general burning of the woods is about the last of February. The weather at this time is usually warm and the grass shoots up rapidly. The cattle recover very rapidly, though for a few days they suffer much from hunger, as the whole country is a charred waste.

About the 1st of April the cattle-owners appoint a time and place of meeting to make a "drive." All the cattle at pens are collected and the owners separate them. After they are separated, the large stock-owners drive fifty or one hundred five or six miles away from any other large body of stock and give them into the care of stock-minders, who have pens built for the separation of the cows and calves, and whose compensation for this service is the milk from twenty to fifty cows and the manure from twice or three times as many dry cattle. The cows average about one quart of milk per day. Since the partial destruction of the range the cows have calves but once in two years. Very little milk is taken from what are called the calf cows, the most of it being taken from the yearlings. All the cattle are supposed to be penned every night, and from one to three acres of ground is what is called "trod." On this "trod" land the stock-men plant corn and sweet-potatoes. Some plant a small patch of sugar-cane. About the last of July or the first of August the calves are all marked and branded, and the whole herd is turned loose to hunt the wild oats on the unburned spots of the early spring. They have free range to gain all the strength they can to take them through the winter. Beef so raised is not good. It has but little flavor, and persons who are able to buy good Texas or Western beef will not buy it if they can get the better. Some few steers eight years old or more make very fine beef late in the fall.

Sheep in this section, like cattle, suffer from few diseases except such as are brought on from neglect. The scab is a common disease among them, and so far as I know but few attempts are made to cure it. It is also a very common disease among goats. Sheep likewise suffer from rot. I have recently tested tobacco as a remedy for this disease. Sheep eat it very readily when it is mixed with their food, and soon become fond of it. If properly used, I think it will effect a cure. The range for sheep is much better than it is for cattle, and they generally keep in good order most of the year.

I have had a great deal of observation, but little experience, with the diseases of hogs. During the war a good many hogs died of cholera, for which there was no remedy. Copperas was used as a preventive with some success. Preventives I believe to be the only safe policy.

ILLINOIS.

Mr. JOHN W. ROSS, Fitt's Hill, Franklin county, says:

Horses in this locality are occasionally affected with epizootic diseases. The malady comes on without any apparent warning. The symptoms are generally about as follows: Glands of the throat swollen and distended, and limbs and feet swollen; contagious eruptive fever, with inability to eat or drink; morbid secretion of saliva, and decided constipation. In fatal cases the disease runs its course in from ten to fifteen days. Hygienic measures are about the only remedies resorted to. Warm poultices may with benefit be applied to the throat, and the bowels regulated with salts or sulphur.

The disease most prevalent among cattle is murrain. It is characterized by small vesicles in the mouth, on lips, gums, and tongue, with drivelings of saliva, often causing inability to eat or drink. These symptoms are accompanied with fever, swelling of the udder, and lameness. In fatal cases the animal generally becomes unmanageable, disregards the commands of the groom, breaks away and runs over the neighborhood perfectly frantic and furious. The disease runs its course within from three to ten days. Where animals are affected with this disease the bowels should be regulated by mild laxatives, and they should have comfortable lodgings, with soft, digestible food. As an application for the mouth and larynx, a mild astringent solution of half an ounce of alum, oxide of zinc, or sugar of lead to a quart of tepid water will be found beneficial.

The most formidable and by far the most destructive disease of all is hog-cholera It often devastates the whole country of large numbers of swine. It occurs at any season of the year, but is generally the most prevalent in spring. The symptoms are a stiffness of joints, no desire for food or drink, dry, hot, harsh skin, general disturbance of internal viscera, nausea, and vomiting. The animal lingers from five to ten days, and generally dies. Decomposition takes place almost immediately after death. Various remedies have been tried, but with no decided benefit.

A disease known as chicken-cholera is also very destructive to fowls. When it breaks out in a flock it usually destroys the most of them. No remedy has been found to successfully combat the disease.

Mr. E. STEVENS, Howardsville, Jo Daviess county, says:

There is no special disease prevalent in this locality among farm animals. Among horses the most troublesome complaint is that known as distemper or "strangles." It is quite prevalent throughout the low country of the Mississippi Valley. It is invariably known here as "distemper," and is of variable duration, often lingering for months, but seldom proving fatal to the full-grown horse. It attacks horses of all ages and conditions, and is highly contagious in its character. The disease is marked by three distinct stages. The first is a dry, hacking cough, attended by running at the nose. The discharge at first is thin and watery, and always of a whitish color. This discharge soon becomes thick and purulent, and the second stage rapidly follows by swellings or tumors under the throat, along the salivary glands. These swellings soon establish an abscess in the throat, which rapidly enlarges until it breaks. This constitutes the third stage. If it breaks outside—which it generally does—matter may run for days or weeks, and sometimes for months, but the danger is passed if proper protection is afforded. But if this abscess breaks inside, the horse generally dies from suffocation or strangulation. The only remedy used here is the application of hot poultices about the neck and throat (in the second stage) to induce suppuration as speedily as possible.

Hogs are generally healthy, but when any die from any cause it is invariably attributed to "hog-cholera," when most likely no such thing as cholera ever existed among hogs in this locality. However, hogs frequently die here with quinsy and other throat diseases. The most successful treatment I know of is to give frequent small doses of powdered bluestone in sweet milk. I have also been successful by placing, with a wooden paddle, half a drachm of finely pulverized bluestone on the roots of the hog's tongue.

Fowls often die with what is known as "chicken-cholera." I know of no sure remedy. Equal parts of powdered charcoal and red ocher mixed with the food is an almost sure preventive.

Mr. J. S. LATIMER, proprietor of Cedar Farm herd of short-horns, Abingdon, Knox county, says:

Diseases of horses in my locality consist in what are familiarly known by our quack horse-doctors as bots and epizootic, or distemper, the first of which affects the horse internally. The remedies usually recommended and applied are too numerous to mention. Each doctor has a different one, and the remedies kill about as often as they cure the animal. No effectual remedy has yet been found, as a horse once affected with the disease never entirely recovers. The epizootic is a malady which affects the lungs and throat, and sometimes spreads to the limbs and body of the horse. We have what is known as regular distemper, which is of a milder form than the epizootic, but both are evidently the same disease. The quacks have different remedies, with none of which am I conversant. The disease attacks and destroys animals ranging from six months to two years of age. It seems to be contagious, and prevails at all seasons of the year. It is usually more fatal to older stock, as about 10 per cent. of those affected die, and those that do not are rendered comparatively worthless.

The cattle in this county, all along the line of the great thoroughfares, are subject to attacks of the Texas cattle fever. In this county we are annually subjected to it. Then we have the disease known as blackleg, which is virtually a blood disease. It affects young stock principally, mostly calves from three months to one year old, and is very rapid in its course. The calf frequently dies within thirty-six hours after the first symptoms of the disease are observed. On skinning the animal, all the blood vessels of the legs and neck are usually found clotted and gorged with black blood. So far no remedies have been found. In certain localities in the county it is more virulent and fatal than in others. When a lot of stock is attacked it usually goes through the whole herd. It is very fatal, and I regard it as contagious. Perhaps 6 per cent. of the young stock of the neighborhood die of it. Usually the calves that are in best condition die first; thin ones are rarely attacked.

Another troublesome and growing disease is that of abortion in cows. The disease is little understood—indeed its causes are a mystery to us all. I believe it to be a blood disease, and under certain conditions contagious. When once started in a herd of cows, let them be ever so healthy, it is apt to affect them all. They lose their calves anywhere from three to seven months' time. Unless well cared for many of those affected will die, or if they do not they will afterwards prove worthless as breeders. I have tried, and seen tried by a great many others, various remedies, but all have proved worthless. Changing from one pasture to another, and separating the well from the affected ones, will sometimes do good for a short season; but the disease will usually break out again, perhaps affecting cows that were previously exempt. The opinion

generally prevails that the disease is contagious. For the past two years I doubt if 10 per cent. would cover the annual losses from this malady.

We annually lose at least 20 per cent. of all our hogs and pigs by a disease commonly called hog-cholera. • Many diseases are classed under this head, and some of them are no doubt the result of local causes, such as bad treatment, confinement in filthy and ill ventilated buildings and pens, &c. Worms in the throat and intestines is one of the symptoms of the so-called cholera. Many specifics are used, but no certain remedy has as yet been found. Copperas, sulphur, charcoal, turpentine, asafetida, antimony, and many other drugs have been tried, but usually without satisfactory results. The disease is certainly contagious, and one of the best preventives is to separate at once the sick from the well hogs, and divide the well ones up into small herds. A change of feed from corn to oats, bran, &c., will also be found beneficial.

Mr. NATHANIEL VOSE, Whittier, Lake county, says:

Last spring, horses here were attacked by what is commonly known as "horse-distemper," with some difficulty of breathing, &c. Their heads swelled to the point of the muzzle, and sores commenced to gather and break on all parts of the head, and discharged freely, with the usual running at the nose. The usual remedies of physic and smoking condition-powders with leather, and in some cases roweling and bleeding, were resorted to, but they were of no avail, as death ensued after one or two months From my observation of a yearling colt, it seemed to be affected like a person with the scarlet fever, excepting there was no difficulty in swallowing food or drink. The gatherings continued and the colt became very much emaciated, yet was able to walk about until it died. Two and three year olds have died with it, but no old mares. It seemed to be a malignant type of horse-distemper. The disease was similar to others which had the distemper very light, only the head swelled enormously in the fatal cases.

The foot-rot in sheep has heretofore prevailed to some extent, but is about eradicated. Sulphuric acid and copperas are the general and successful remedies.

Last year there were some losses by hog-cholera, but no cases came under my personal observation. This stock is generally healthy hereabouts. A short time ago I noticed one of my pigs had what I believe is called the "thumps." This was the only case I ever saw. The pig would pant or jerk almost like a person with the hiccoughs, only the jerk seemed more in the abdomen than in the chest. It grew thin and died after about six weeks.

Mr. FRANK HERR, Waterloo, Monroe county, says:

For the past year the hogs in my neighborhood have been more or less afflicted with malarial fever. The disease commences with red and sore eyes, which symptom lasts a day or two, when the hog grows stiff, shivers with cold for a few minutes at a time, with intermittent heat as of a fever, after which it dies within from three to four hours. My remedy is twenty-four grains of quinine, given in sugar and sweet milk, in three doses a day; or given in apple-butter forced down the throat, if the animal no longer eats. I found this a pretty effectual remedy. I give pigs three or four grains of quinine per day in some manner.

I have seen a few cases of milk-fever among cows, which generally killed them within from six to fifteen hours. The most lingering case extended into a period of three days. I had good success in administering Glauber salts and saltpeter in reasonable doses. In the early stages of the attack I gave cold water injections every two hours. If badly constipated I also gave one-half pound of Glauber salts and a half pint of raw linseed-oil at intervals, until a passage was effected. I then gave two drachms of pulverized camphor in strong valerian tea and kept the cow warm.

Mr. JAMES C. FAIRBANK, Concord, Morgan county, says:

In cattle some heavy losses have been sustained from "Texas fever," so called. The disease has been confined mostly to native cattle in this vicinity, and to these only in cases where they have been in the same pasture, lot, or cars, or across the track of the Texas cattle. It does not seem to be contagious from being near in separate pastures. About two weeks after exposure the cattle cease to eat and soon die. In one case a man had eighty head of extra fine cattle just ready to ship. In August he bought a lot of Texas cattle and turned them into his pastures. He then changed them, putting the native fat ones in the pasture where the others had been. They soon after commenced dying, and nothing seemed to check the disease until eight had died. They were sixteen-hundred-pound cattle. A neighbor went to Kansas and brought in thirty-five or forty head of steers weighing about twelve hundred pounds each. He did not know that they had been exposed in any way, and they could not have been except in the cars or in lots where they were temporarily quartered. Just two weeks after, and before he knew anything was wrong, two of them died. He finally lost nearly half the lot. Some effort was made to doctor them, but without success. The disease always disappears with heavy frosts.

Several cows have recently died, just after calving, with milk-fever. The only

thing I have known to help them was to drench freely with melted lard and turpentine; say one pint of lard to two tablespoonfuls of turpentine, and repeat the dose, if necessary.

The hog-cholera, so called, has been the greatest scourge we have ever experienced. During some years from 60 to 75 per cent. of the hogs are lost by it. The usual symptoms, as now manifested, are a loss of appetite, cough, an inclination to scratch and sometimes to thump, and general lassitude. They then incline to "pile up" in their beds, and many of them die during the night. No purging or vomiting is observed, but rather a severe constipation, and the excrement is dry and hard. Many die just after drinking, especially fat ones. Some will eat their regular amount of feed until just before death, while others will become greatly emaciated and linger for weeks before death relieves them. Mr. Thomas Danby, of the English settlement, says he had a large sow to lie three weeks without either food or water, and then get well. Some years since a few of my fat hogs cracked open on the back. These cracks extended to the bone, and in some cases the fat and flesh sloughed off. A few affected in this way recovered.

Most hogs that die of cholera will bear gathering up and hauling to the grease factory; but a neighbor of mine, who had some very fat ones die of a sort of congestion, attempted to skin them, but they were so offensive that he had to desist. The blood had settled all through them, and had turned the fattest portions of them very black. The bones were very tender and apparently rotten.

The disease seems to have no fixed or certain symptoms. Sometimes it will only attack young pigs, and only ceases when there are none left to kill. Entire litters often die, while the mother remains comparatively healthy. In other instances only fat hogs may be attacked, but generally the heaviest losses are sustained among shoats weighing from 75 to 125 pounds. Very often it sweeps over a whole neighborhood and rages as a contagious epidemic. In such cases only those exposed to the disease suffer, while isolated herds remain exempt. Upon the first evidences of the disease it has got to be the practice to separate the hogs and scatter them over the farm as much as possible, and if they are being fed on dry food to change them to grass. This course seems to have a tendency to check the disease. The losses generally range from 25 to 80 per cent. of all the hogs; sometimes it reaches even higher than this. I made an estimate once of a circle of one mile, taking my own place as the center, and within that circle 66 per cent. died. Mr. Danby, spoken of above, lost one hundred and sixty out of two hundred head.

The so-called cures are various, but as cures they are mostly failures. Preventives are often used with great benefit. But, however strangely it may seem, what may be successful as a preventive or cure in one case may utterly fail in others. Mr. Danby tried turpentine, using in one season ten or twelve gallons mixed in swill, but without success. He now feels that he has found a sure remedy in the use of quick-lime, ashes, and salt. He feeds it to his hogs once or twice a week, and if they are coughing and not eating with their usual relish he keeps it constantly in their feed-troughs. Since he commenced using this preventive he has lost no hogs. Mr. Carter, a relative of mine and a large hog-raiser, says he has never been troubled with cholera to any great extent. His reliance is upon the use of turpentine, salt, and ashes, regularly and steadily given.

J. M. Thompson, a neighbor, thinks he has a certain preventive, and sometimes a cure for the disease, in a mixture composed of arsenic, copperas, sulphur, asafetida, lime, salt, and ashes. He feeds to them once a week, and, if cholera is around, oftener. He regards arsenic as the main ingredient. Samuel Newton recommends to every one the use of copperas, sulphur, and black antimony. He says their constant use has proved of great benefit to him, as well as to others to whom he recommended the prescription. Mr. H. Engleback fed a large number one year on slops made from shipstuff, bran, &c., in which he constantly used soda. He had good success, while others immediately around him, who fed on corn, lost heavily. Some use ashes, sulphur, and salt, others copperas, ashes, and salt, and still another salt and ashes. These are generally used as preventives. If the hogs have cholera asenic is given, and if they are past eating they are drenched. During one year my son utterly failed with all these articles. Nothing whatever seemed to do his animals any good. They were large, fine, fat hogs, in apparent good health, yet they died daily. After a great many died he was advised to use mutton tallow. When this was used freely it seemed to check the disease, but when he ceased to use it, because of the expense, the disease returned with great fury, and swept off from 60 to 75 per cent. of those left. He is now using J. M. Thompson's remedy, and so far with success. I know of one case where a hog, seemingly almost dead, was cured by drenching with melted lard and then giving it Mr. Thompson's arsenic mixture. The experience of all seem to be about this—preventives are a success if used regularly and judiciously, but if the hogs are once attacked there is nothing that will prove of much benefit. I think the disease is both epidemic and contagious. I have been through two sieges of it. In the first instance it was evidently epidemic, passing from east to west, and taking all in its course. In

the second instance the disease was imparted to my herd by an infected shoat that found its way into my inclosure.

I forgot to mention in the proper place that I found some benefit result from burning and charring the carcasses of the dead hogs and feeding the refuse to the living ones.

Mr. J. BALSIGER, Highland, Madison county, says:

As far as I can learn no epidemic or prevailing disease has shown itself among horned cattle in this county since the year 1874, when a herd of Missouri cattle brought the so-called Texas fever into the northern part of the county, and quite a number of this herd died in a few days thereafter. My correspondent at that point writes that the remaining part of the herd was sold as soon as possible, and no contagion remained. Formerly, when cattle pastured on our wild prairies, many died of a disease called "bloody murrain," but since they have their run on tame (mostly bluegrass) pastures, I have not heard of any cases of this disease. I believe it has entirely disappeared. To insure safety from disease good pastures might be recommended, and also good but not too abundant feed; good shelter during stormy weather, particlarly in winter-time, and cleanliness and regularity in feeding and salting. Some experienced farmers advise throwing the salt on the ground, as animals require a certain quantity of earth to keep them in good health.

A disease from which many valuable milch-cows die is the so-called milk-fever, by which they are attacked soon after calving. Cows—very well-fed and fat ones—are almost exclusively exposed to attacks from this disease, which kills them in a very short time. I believe no remedy is known. A preventive is said to be found in giving a cathartic medicine just before calving and in the reduction of feed some time before.

Excepting the occasional visitation of contagious diseases, I believe the horse need seldom be sick. By a free use of charcoal and wood ashes, the stomach of the horse can be kept in good condition. The stomach being all right, we need not fear sickness, except from distemper or other contagious disorders. When the epizootic was here our horses were frequently fed with sour apples, and the disease was scarcely perceptible on them. I believe more horses are killed by bad feeding, and in giving too much and too strong medicine, than die by disease. This is what one of my correspondents—one of the best and most experienced farmers of our county—writes to me on the subject of horses.

A little care and attention will keep sheep healthy. Sheep readily contract colds. Their coats fill with rain-water and snow if exposed to storms, and they are then about as comfortable as a man would be in like condition. The young and strong do not feel it so much; but the older ones sicken, dwindle away, and many times die, and it is attributed to different causes and ailments. Scab is only introduced into flocks by contagion. Grub in the head can generally be prevented by the use of pine tar and low sheds to run into during hot weather. Ticks, scab, and skin diseases of every kind may be kept at a distance by the frequent feeding of sulphur.

The so-called hog-cholera has prevailed to a considerable extent in this county for some years past, and a great many hogs have died, but not so many, so far as I can learn, during the year just ended as formerly. Loss of appetite, in some constipation, in others a diarrhea, and a purple color of the skin, particularly on the belly, were the symptoms. The duration of the disease was seldom more than two or three days. As preventives, the following treatment is indicated. A free run in a good pasture, abundant and pure water, feeding of vegetables, clover, and fruits, in preference to corn, during the hot season; free access to stone-coal (some say also charcoal), which contains a considerable amount of sulphur. A good effect has also been observed from the mixing of soft soap with the slops given them. A cooling diet, rather than rich and heating food, during the summer particularly, appears to be of importance as a preventive. About twenty years ago, when several of my own hogs died from this disease, I succeeded in stopping it by the use of the following prescription: Sulphur, 2 pounds; madder, 2 pounds; saltpeter, 1 pound; black antimony, half pound, well mixed, and given at the rate of one spoonful to each hog twice a day, with milk, gruel, or anything they would eat, drenching those that were too far gone to partake of food.

Other diseases among hogs will sometimes appear, but they are not epidemic or contagious—they are less frequent, less dangerous, and therefore less important. It is, therefore, not necessary to notice them.

Fowls also are sometimes afflicted with so-called cholera. Symptoms: Loss of appetite, thirst, diarrhea, and the discoloration of the comb, which turns black. They die in a very short time. The cause, or at least one of the causes, seems to be in keeping too large a number of fowls on the same place. Saleratus, mixed with their food, is said to be an effectual remedy. Boiled barley is also highly recommended. Improved breeds, as Shanghais and Bramahs, and perhaps others, appear to be subject to apoplexy. They will drop down dead suddenly without any indications of sickness. I know of no remedy.

INDIANA.

Mr. S. H. BIDDINGER, Westport, Decatur county, says.

Inflammation of the kidneys is a common disease here among horses. The early symptoms of the disease are those of fever; the horse is nervous and frequently looks around at his sides; stands with his hinder legs wide apart; is unwilling to lie down; shrinks when the loins are pressed, where some degree of heat is felt; the urine is voided in small quantities: frequently it is highly colored and sometimes bloody. The treatment consists in bleeding freely; next an active purge should be administered and counter-irritation excited as near as possible to the seat of the disease. For this purpose the loins should be covered with a mustard poultice. The horse should be warmly clothed. No diuretic should be given, but after the first effects of the purging have ceased small doses of white hellebore with tartar-emetic may be given. The animal's legs should be bandaged and plenty of water offered him. His food should also be carefully examined.

I have had some experience with the disease known as hog-cholera, and regard it as either a congestion of the lungs or of the bowels. A *post-mortem* examination disclosed the fact that those that run off at the bowels show a diseased condition of the liver and bowels, while those that are not affected with diarrhea die much sooner than the former, and present a highly congested condition of the lungs. Remedies that have proved efficacious in my practice are such as sulphur and coal-oil or sulphur and linseed-oil given in small doses twice a day until relief is found. Two drams of sulphur to one ounce of oil is the proportion I use.

Chicken-cholera is first observed by a moping or stupid condition of the fowl. *Post-mortem* examinations show an enlarged condition of the liver. I have relieved fowls affected with the disease with a strong butternut-bark ooze mixed with thin feed. Small doses of calomel also relieve them.

Dr. D. W. VOYLES, New Albany, Floyd county, says:

There has been no prevailing epidemic in this section of the State within the past few years affecting any class of farm-animals, except swine and fowls; and in these cases almost all complaints resulting in death are summed up by the people as "hog" or "chicken" cholera. In few cases of disease of this kind that have come under my immediate observation are found any symptoms analogous to the disease of that name as affecting the human species. The treatment has been as empirical and irrational as the diagnosis has been erroneous.

As to swine, the diseases, whether one or many, have created or caused a fearful loss to our farmers, and discouraged them in the further pursuit of that branch of stock-raising; and while almost all sections are more or less affected, there seems to be more disease and greater fatality among the farmers operating in the rich valleys of White and Wabash Rivers; and the disease and loss has been, I think, greatest during those years of great overflow, and greatest during the years in which the overflow occurred late in the season, leaving with its sediment the luxuriant growth of vegetation to decay and evolve miasmatic effluvia. From these facts I think much of the loss is caused from diseases brought on by exposure to miasmatic influence.

I am not conversant with any scientific investigations that throw much light upon the cause of these diseases, or the pathological conditions found on *post-mortem* examinations in such animals as have died. No treatment has yet been discovered by our farmers so certain in its curative effect as to inspire them with the belief that hog-raising is sufficiently safe from loss to insure profitable results. I am fully persuaded that so long as they content themselves in ascribing to all deaths the one common cause, "hog-cholera," and adhere to the present plan of empirical treatment, instead of patiently and scientifically investigating the causes producing disease in swine, and the various kinds of disease to which that animal is liable, giving to each its distinctive rational treatment, the subject will remain a mystery, and the fearful mortality continue to increase. That the farming population of the country, as a class, are not sufficiently educated to undertake this work, is a fact too well known to be disputed; and inasmuch as the great loss from that class of animals alone is not merely an individual loss, or the loss of a particular class of our people, but through them a great national loss, it is unquestionably within the range of the duties of the general government to undertake the extensive investigations which alone can accomplish this result.

What I have said in a general way in regard to swine applies with equal force to fowls. The loss, from whatever cause, is due to "cholera," in the opinion of most farmers, and astringent drinks and iron mixtures are given, whether the fowls are purging or are constipated from congestion from overfeeding, dying from starvation, or eaten up by vermin, or diseased from the foul air that arises from the filthy excretions remaining in their pens, unmoved for months, or from any of the many other causes affecting their health.

No fatal disease has prevailed epidemically among horses in this part of the country within the last few years, and this animal, therefore, is admitted by common consent to be liable to quite a number of ailments, requiring different causes for their production and slight modification in the administration of remedies for their cure; but in the case of the horse, the naming of a prevailing epidemic a few years since has unfortunately caused all bronchial and catarrhal affections to be grouped under one common class and name—"epizootic." In the treatment of this animal for whatever disease, we generally witness the heroic empiricism practiced upon the iron constitutions of the people of two centuries ago (who sometimes triumphed over both the disease and the doctor), by a selection of remedies from among the most poisonous and potential that can be found described in *materia medica*. All structural enlargements that do not warrant their removal by the surgeon's knife, instead of being slightly stimulated locally, in addition to such internal treatment as is calculated to favor their absorption and natural removal, are plied with blisters and the cautery until the country is filled with valuable animals scarred and crippled for life—living monuments of the ignorance and savagery of their owners and masters.

These facts, which I think are not overdrawn, show the impossibility of my giving you any tabular statement of diseases properly classified, and the treatment given under any proper head, because the several diseases affecting each class of animals have not been investigated, and are neither understood nor rationally treated. What I have been able to contribute, therefore, can serve only to show the great necessity for scientific investigation. The treatment of domestic animals in the West is generally committed to self-styled veterinary surgeons, whose experience is alone their guide, and that often founded upon the service of keeping some gentleman's horse, observation in a livery-stable, or as a common loafer around the neighborhood of breeding establishments.

Mr. JOHN Q. A. SIEG, Corydon, Harrison county, says:

We have but few malarious or contagious diseases among farm-animals in Southern Indiana. Incident to the hog, we have what is known as cholera, quinsy, and measles. The cholera, in my judgment, is typhoid fever, and is very contagious. I have examined some hogs that died with what was called cholera. The symptoms seem, from what I have noticed, to be about as follows: First, prostration with dullness and stupidity; in most cases diarrhea with chilliness and irregular fever. Subsequently there is an increase of the cerebral difficulties, dry skin, tenderness of the abdomen, particularly the sides of the same, an eruption of purple spots on the abdomen and thorax, and generally a cough. Usually, in eight or ten days, mortification of the bowels sets in, and the hog dies. Now and then a hog gets well, but it is an unusual occurrence. All remedies so far are failures. I would advise keeping all hogs inclosed, and not permit them to run at large: then if a hog should become diseased, isolate it immediately. Before adopting this plan I lost a great many hogs, but since practicing it I have lost but very few, and what I did lose were infected from hogs lying around inclosures where mine were confined. I am therefore of the opinion that if this rule was adopted by farmers generally, that what is known as hog-cholera would almost disappear.

Quinsy, I think, is the same disease as that which afflicts human beings, and requires about the same treatment. Measles never kills a hog, but if butchered while afflicted with the disease, the meat is unfit for use.

In sheep no disease except foot-rot prevails, and that only occurs in low, damp ground, or by stabling in a damp, unhealthy shelter. As a remedy, the sheep should be removed to high, dry ground, and separated from the well ones. Then take carbolic acid, weaken it with water, and inject the solution into the feet of the sheep every other day until a cure is effected, which usually takes from six to ten days.

Chicken-cholera prevails to a greater extent than any other disease, and causes more loss. It is not confined to chickens alone, but affects ducks, geese, and turkeys alike. No remedies have been discovered that have proved of any benefit. I think good, clean, healthy apartments, with plenty of nutritious food and a good range, will greatly tend to prevent the disease. I have noticed that during the butchering season on the farm fowls are entirely free from disease, and I would infer from this that plenty of meat tends to prevent many of the maladies to which they are subject.

Mr. JOSEPH HOLE, Butlerville, Jennings county, says:

I am pleased that you are taking steps toward having an investigation of the causes of the fearful maladies to which farm-animals are subject. I shall be very glad to render you any assistance in my power for the furtherance of so laudable an object. Horses, cattle, and sheep are comparatively healthy. Chicken-cholera prevails to some extent, but not sufficiently to affect the interest.

The hog disease has prevailed in this and adjoining counties for several years, more, I think, as an epidemic than as a contagious disease. Cholera is a misnomer, so far, at least, as a large majority of the cases coming under my observation are concerned.

Perhaps erysipelas or diphtheria would better describe the disease, although neither of these would, in all cases, be correct. What renders a description of the disease more difficult is, that while there are some general symptoms, such as loss of appetite with strong febrile tendencies, yet in a herd of hogs there will be a great variety of forms of attack. Thus several cases of sudden and complete paralysis have occurred. While the hog, previously in good health, was running for the feed prepared for it, it has been stricken down precisely as when shot in the brain with a bullet. In such cases, *post-mortem* examinations fail to discover any unnatural appearance of the intestines; but the condition of the lungs generally indicates strong symptoms of congestion.

One of the common symptoms that precede an attack of the disease is a dry, hacking cough. This, however, may continue for months without any further manifestation of the disease, though generally it is followed by the next symptom, a loss of appetite. And here any of the forms incident to the disease, and which no one can foretell, may set in. Intestinal fever is a common attendant of the malady. In my own observation the bowels, as a rule, are constipated, the animal passing only small, hard pellets. Very rarely fetid diarrhea is observed. About 70 or 80 per cent. of the cases prove fatal. Of those that recover, complete convalescence is not established under six or eight weeks, and even then no one will buy them if those that have never been affected can be had.

No panacea has been found for this terrible disease, nor has any treatment been tried, so far as I know, that can be recommended. The use of antiseptics is perhaps the best treatment. Bisulphate of soda, sulphate of iron, turpentine, charcoal, opium, nitrate of silver, carbolic acid, and creosote have all been tried, and all have failed in bad cases. Preventives are better than cures. As a rule, those who give their hogs the best feed while in health, and look most carefully to their sanitary condition, escape with less loss than those who are less careful.

Mr. A. B. McKee, Vincennes, Knox county, says:

There are but two diseases, so far as I know, that prevail as epidemics in this section of country, viz., hog and chicken cholera. The hog-cholera has become one of the most serious diseases with which the farmer has to contend. He may think he has a fine killing for the winter, but the cholera enters, and in a few weeks he finds himself left without enough for his own family supply. The disease presents so many different phases as to prevent me, with the little investigation I have given it, from attempting a complete diagnosis. A drooping of the head, loss of appetite, and an indisposition to move are among the first symptoms noticed. Sometimes there is a running off at the bowels, and sometimes constipation prevails; sometimes they die in a few days, and then again they may linger for weeks. I confess I do not understand either the pathology or the workings of the disease. As to the cures recommended, they are numerous, and generally based not upon a scientific analysis of the remedies prescribed, but upon the vague conceit of the party recommending them; and then, again, all the different remedies in turn have proved failures. If Congress would do anything to throw light on this subject, and especially if a specific could be found, it would prove of incalculable benefit to the whole country.

I have used, and I have thought with some benefit, alum and Venetian red—alum as an astringent, and Venetian red as an absorbent. During the past summer I have used poke-root, given in slop, in such doses as to secure its alterative effects, and as a preventive rather than a cure. From its known effect as a preventive in other diseases I have no doubts as to its beneficial effects in this.

Mr. A. M. Sanderson, Leesburg, Kosciusko county, says:

A friend of mine had a fine lot of hogs this fall, varying from pigs to fat hogs. He has lost nearly all of them by some disease, probably the cholera. They were on wheat stubble after harvest, and then on clover pasture. When first taken their evacuations were dry and hard. This condition continued about three days, when diarrhea would set in, and they would die within a few hours thereafter. Nothing was found to do them any good.

There is a new disease in this locality among horses, called by farriers pink-eyed distemper. The horse, within a few hours after the attack, will become stone blind. Some get over it, while others only partially recover their sight. The eyes matter and run a great deal. The treatment thus far has been merely experimental—what would seem to relieve one would not benefit another.

Chickens in some localities have nearly all died of cholera. In my own experience I have found sulphur the only remedy. Mix with corn-meal and feed. With this remedy I have cured fowls that could not stand up.

IOWA.

Mrs. Mary E. Donley, Knoxville, Marion county, says:

Hog-cholera has been raging all over our county for several years, and so fatal has it proved that it is regarded as incurable. Many remedies have been proposed

and tried with no good effect. The symptoms are, the animal is seized with a hacking cough, similar to that of bronchitis, refuses to eat, and turns of a purplish color. I have seen some on our farm where the ears would become badly swollen, and blood would ooze out of them before death. Diarrhea generally ensues. We have thought that in several instances a change of locality abated the disease. Death generally occurs in two or three days; however, in many instances, they are dead before you know anything ails them. I suppose ninety-nine out of every hundred die, or ought to, as they never do any good afterward.

Diseases among cattle are not much dreaded, that known as black-leg being perhaps an exception, I do not know any symptoms; generally find the animal in a helpless condition. If taken in time, the disease can be cured by an application of turpentine on the back, over the hips, and on the swollen parts. Must be bathed in with a very hot iron. In fatal cases the animal lives about three days.

Sheep here have become so badly diseased with scab and foot-rot as to make sheep-raising very unprofitable. We find that thorough dipping in tobacco-tea is a certain cure for scab. I have also heard that if blue vitriol is mixed with water and the sheep compelled to walk through it once a day for a few days it will likewise effect a cure.

The raising of poultry is not considered near so profitable as in former years, because of the ravages of cholera. The fowl mopes around or remains on the roost until it dies, which is a very short time. After death, the liver is found swollen to about twice its natural size. The heart is also found enlarged. I am sure I have checked the disease several times by using the following recipe: One tablespoonful of finely-ground black pepper, same quantity of alum, and one teaspoonful of soda, mixed in one gallon of sour milk, and placed where the fowls can drink as often as they choose.

KENTUCKY.

Mr. W. P. Render, Point Pleasant, Ohio county, says:

Horses here are subject to various diseases. The first is weak eyes, which seem to be hereditary. As a preventive I would recommend more care in breeding. The second is fistula, which is an ulceration of the top of the withers, caused by a hurt or bruise of the main sinews of the neck where it joins the top of the shoulders. This disease is not necessarily fatal, though it requires a great deal of care and nursing after it has commenced running. There are various remedies. Some veterinarians burn with soft soap and whisky before the pus has formed, while others rub with turpentine and warm in with a hot iron. After the fistula has commenced running, a liniment made of May-apple root is the most effectual remedy. It should be used two or three times a day, with repeated washings with soap-suds. The third is tetanus, or lock-jaw, which is a fearful disease. The horse, when taken, shows a very restless disposition; the head protrudes forward; the eyes roll back and seem to sink in the head; the hind feet are drawn under; the tail is extended, while all the muscles seem drawn to their utmost tension; some fever, with short and hurried breathing. It is caused sometimes by a hurt and at other times by overheating. Full 75 per cent. of the cases end fatally. The attack is of short duration, lasting only from two to four days. We often bleed freely from the neck vein, which, in cases caused by overheating, is sometimes effectual. In cases caused by a hurt I am of the opinion there is no remedy whatever.

With the exception of a few cases of abortion in cows, cattle and sheep are generally healthy.

Hogs are affected with a lameness which seems to be a forerunner of the cholera. They become lame in one or more of their feet; have ulcers on their joints, which last in some cases twelve months. Some have sores at every joint and finally get well and make good hogs. We have no remedy.

I have known some instances of chicken-cholera where all the fowls on a farm have died. They fall from their roosts and die during the night. Like cholera in the hog, there seems to be no remedy.

LOUISIANA.

Mr. J. P. Behrnes, East Baton Rouge, says:

Charbon often prevails in this section of country, but we have never had a case on the place. I am sure that nine cases out of ten die from the violence of the treatment. Foot-evil, or the scratches, is liable to occur every May—particularly in May, I think, from the heavy dews, but I find no trouble in arresting it with an ointment made of hog's lard and black sulphuret of mercury. Latterly I have found carbolic acid and ointment to do as well, unless the disease is neglected too long, and the hoof comes off.

I had several cases of black tongue among my cattle last year, and cured them by rubbing the tongue and mouth with a simple ointment of lard and carbolic acid. Cattle, as a general thing, in this section are mostly free from disease. Imported stock from the North or West are very liable to die, and are peculiarly susceptible to disease, because our native pastures are not nourishing to them. We must grade up our grasses before we can successfully grade up our cattle. Sheep thrive well. Foot-rot sometimes does harm, but is cured by anointing with pine tar and separating from the flock. An abundance of salt will prevent distemper. Hogs also thrive well. In some parts of our parish cholera has prevailed, for which no effectual remedy has been found. I keep my hogs all summer on cotton-seed, and never lose any by disease. Diseases among fowls appear among the Asiatic strains. The small common breeds are hardy and prolific of eggs.

MARYLAND.

Mr. C. GINGRICH, Reisterstown, Baltimore county, says:

A disease has been prevailing among cattle in the vicinity of Baltimore for the past twelve or fourteen years, and in many cases has proved fatal. As most of the cattle in this district are milch-cows, the disease prevails most extensively among them. It is commonly called lung-fever, but as it is identical with pleuro-pneumonia, it should perhaps more properly be called that. It has thus far baffled all medical skill. It seems more malignant where a large number of cows are confined in filthy stables. I know of several dairymen who were compelled to suspend their business on account of heavy losses by the disease. Renovating the stalls, whitewashing, using carbolic acid, carbonate of lime, and smoking the stables with tar, &c., have had the effect to check the disease for a time, but it is liable to break out again. The symptoms are a cessation of the milk secretion, loss of appetite, and stupor, accompanied with quick pulse and high fever, and secretions from the nose and mouth. Some animals die within a few days, while others linger for some time. Fresh cows are more liable to attack than dry ones. Nearly every case proves fatal. The disease is undoubtedly typhoidal in its character. Some years ago a bill was introduced in the legislature providing for an investigation of the disease, but it failed to pass.

There is no class of animals among which such heavy losses occur as among swine. There is certainly something wrong in the rearing and management of hogs, as the losses sustained amount to millions of dollars annually. I am of the opinion that the cruel system as now and for many years practiced has a great deal to do in inducing disease among this class of animals. The hog is an animal that cannot endure such hardships as horses and cattle. In the Western and Southern States swine diseases prevail to an alarming extent. In these States a most cruel and injudicious system is practiced in the rearing of the animals. Raised without shelter either from the burning sun of summer or the cold storms of winter, it should not be wondered at that they contract disease and die by the hundreds and the thousands. Young shoats should not be fed entirely on corn, as this feed produces an abnormal growth which results in a weakened vitality, and generally ends in cholera or some other disease incident to these animals. In the Eastern States and other localities where the hog is raised under a better and more careful system, cholera and other diseases are not known. I believe if a better system were adopted that cholera and many other diseases to which the hog is now liable would be almost entirely banished. We have sustained heavy losses in this county, and must continue to do so until a change is made for the better in the treatment of swine. So long as hogs are confined in dirty, filthy, muddy pens, and fed on nothing but dry, hard corn, we must expect them to sicken and die. The cholera, so called, is also typhoidal in character, and this opens up a wide field for investigation.

A disease prevails among the poultry of our county, which has been very destructive. Some farmers have lost their entire flocks. No remedy has been discovered. Preventives are used with some success. The poultry-house should be large and well ventilated and whitewashed frequently. The droppings should be removed every few days, and near the door, exposed to the rain, should be placed a good quantity of lime. They are fond of this and will eat it every day.

Mr. R. J. WILLOUGHBY, Federalsburg, Caroline county, says:

We have a disease among fowls here which seems to affect but two classes, viz., turkeys and barn-yard fowls. The disease is generally known as cholera. It is very fatal, and kills entire flocks sometimes within the short space of twenty-four hours. It seems to strike in spots. For instance, while the flock of one farmer may be entirely decimated, that of another, who may not reside three hundred yards away, may entirely escape. We have not been able to find any remedy for the disease.

A number of horses were lost during the past summer and fall by farmers in the adjoining county of Dorchester by a disease known as blind-staggers. A remedy for the

disease was extensively used and proved quite successful. It was to split the horse's forehead and bind horse-radish in the cut. In every case where this remedy was used in the early stages of the disease the animals recovered. From sixty to eighty horses died of the disease in that county.

MICHIGAN.

Mr. JAMES A. LEE, Dowagiac, Cass county, says:

Stock in Michigan is subject to but few diseases. Horses generally have the distemper when growing, which runs from one to two weeks. It commences with a slight cough, watering of the eyes, and loss of appetite. As the disease progresses the cough increases. The throat and jaws swell, gather and break, when the horse becomes unable to swallow, and dies of suffocation. The disease will yield to mild treatment, such as sweating the head and throat with bitter herbs, viz., wormwood, catnip, hops, &c., and smoking the head with sulphur and old shoe-leather. Take a ball of good sweet butter as large as an egg and put it down the horse's throat twice a day. Give mild physic if the case needs it, and keep the horse warm.

The most common complaint among horses is colic. The symptoms are extreme uneasiness. The horse paws, lies down and rolls, gets up and lies down again, groans, begins to bloat, and continues in this way until death ensues unless relieved. This can invariably be effected, if taken in time, by a dose of one-half pint of salt dissolved in a quart of water. It should be administered every ten minutes until relief is afforded, which generally occurs after the third dose.

Worms of different kinds affect the horse and are very troublesome. The symptoms are tight skin, rough coat, irregular appetite, and the appearance of a yellowish mucus under the tail. The horse lifts one hind foot to the belly, draws himself up, partly lies down—perhaps entirely down—on his belly, gets up immediately and goes to eating, stops suddenly, and does the same thing over again. Give a common tablespoonful of copperas in a ball, followed by a bran-mash once a day until relieved; then give a light physic or turn to grass.

We have nine head of cattle affected with horn-distemper to one affected with any other disease. I am well aware that there are many learned men who say there is no such disease, yet I know by forty years' experience the truth of what I write. The animal has a staring look and a yellowish deposit in the corners of the eyes next the nose, grinds its teeth, hair stands up, tail soft two or three inches from the end, bowels varying from costive to laxative. This continues sometimes for years, and is attended at times with loss of appetite and strength. The pith of the horn decays and is discharged at the nose, and finally the membrane over the brain gives way and death ensues. Cure: Cut two inches off the end of the tail to start the blood, and the bone will be found lacking. Take one-half pint of sharp cider vinegar, put in a tablespoonful of black pepper and same of salt; dissolve well. Then take the animal by the horn and nose while some one injects one-half gill of the liquid in each ear. If very bad, so that the animal is down, bore the horns with a spike-gimlet, and inject some of the liquid with a syringe. Give a tablespoonful of copperas and saltpeter in a ball or mash every day for a week, then every other day for another week. Sometimes a cow will be in full flesh and drop a calf in midsummer, give plenty of milk, and do well for a few days; the next day give no milk, and perhaps not be able to get up at all. For this trouble give the above treatment, with an occasional slice of fat pork. Let the chill be taken from the water she drinks, and a cure will be effected. Garget is a very troublesome disease in milch-cows. The cow becomes feverish, the udder especially. Sometimes the milk will be streaked with blood, and again appear lumpy, or both. Wash the bag with bitter herbs steeped in vinegar. Give a tablespoonful of poke-root, pounded fine, in a bran-mash, twice a day. Also, insert a seton in the brisket with a piece of poke-root.

Hog-cholera is increasing to an alarming extent. The first symptom is generally observed in the animal carrying his nose near the ground, with a generally dull appearance, slight cough at first, and swelling under the throat. Some are first taken with severe purging. All these symptoms increase in intensity until death ensues, which usually occurs in from twenty-four to thirty-six hours. No cure has yet been found. Strong wood-ashes and copperas are regarded as preventives. I have cured some by drenching with copperas, sulphur, and asafetida.

MISSOURI.

Dr. R. BUCKHAM, Phelps city, Atchison county, says:

Our loss in hogs by what is improperly called cholera has been very great. In the winter of 1865-'66 the losses amounted to at least $100,000. The symptoms are gen-

erally stupor, indisposition to move, stiffness in the joints, eyes weak and watery, sometimes red; constipation of the bowels; discharges black and hard at first. In some cases diarrhea sets in with bloody discharges and vomiting; high fever and great thirst; occasional bleeding from the nose; in some cases they have cough, in others none; the skin turns a dark purple on the sides, abdomen, and throat. The duration of the attack varies from one day to a month. I think about 80 per cent. of those attacked die. Those that recover peel off like a child with scarlet fever. *Post-mortem* examinations reveal the following diversity of phenomena: Congestion of the kidneys; blood in the ureters and bladder. In other cases these organs appear healthy, and the bowels contain a green, degenerate bile of an acid character; in other cases the liver is black in a state of decomposition with empty gall-bladder; again the spleen is congested and distended to three times its normal condition. In some cases the lungs show inflammation, with dark spots interspersed through them; and again, in some cases, the stomach contained a green acid fluid, the action of which had destroyed the mucous coating of the walls of the stomach, rendering it not thicker than brown paper. It will be seen from this that different organs are affected in different hogs afflicted with the same disease. I have paid particular attention to the progress of the disease, and I am satisfied it is contagious. In all cases where healthy hogs have come in contact with diseased ones they have been infected. I know of no remedy. We have tried everything recommended, but without success. The only safety is in preventives, and the surest preventive is to keep sick hogs away from the well ones.

A few cattle have been lost, in pens, by a disease which seems not to be understood here. I am told by those who have made examinations that after death dark congested blood is found about the joints. There is no cure that I know of.

Cholera exists among fowls, and it is quite fatal. About 50 per cent. of those attacked die. Smart-weed, cut fine and mixed with dough or given in strong tea, is a good remedy.

Mr. John T. Gibbony, Lamar, Barton county, says:

Cattle have suffered considerably in various portions of this county, and quite a number have died from Texas fever, a disease contracted from herds of Texas cattle which were driven through the county. I have heard of no successful remedy for the disease. The contagion was confined to the different localities through which the cattle passed, and did not spread.

Hog-cholera carried off a number of hogs during the past year. Those on the prairies did not suffer to such an extent as they did in other localities. The disease seemed to be more prevalent in the timber-lands and along its margins. Here the hogs were allowed to run at large in great droves. The land was low, and in some places wet, while on the prairies it was dry; besides, they were confined together in small herds.

Mr. George S. Selvidge, Wheatland, Hickory county, says:

Since the passage of State laws prohibiting the grazing of Texas cattle on the prairies, mature cattle have been healthy. Calves are often affected with a disease known as "blackleg." About 90 per cent. of those attacked die. The symptoms are lameness in one leg (more generally, I believe, the right forward leg), ears pitched forward, and nose dry. This condition lasts from ten to thirty-six hours, when one in ten will probably begin to recover; the other nine, of course, die. I have tried blood-letting and active cathartics without effect. I have not known any other remedies tried. A rather remarkable feature of this disease is that the fat, well-fed calves are generally the first attacked, and if any escape it is the lean ones. This feature of the disease has led some breeders to adopt as a preventive a seton passed through the loose skin on the under side of the neck, by which a slight suppuration is kept up. Those who have tried it claim that this is an absolute preventive.

Sheep are healthy here, with the exception of an occasional case of scab or foot-rot, diseases too well known to require mention.

Under the head of diseases among hogs many pages might be written. In 1876 our farmers lost heavily, probably one-fourth of what should have been their income for the year. Some lost all, after feeding out the enormous crop of 1875.

The disease is what is generally known as hog-cholera. It presents itself in three distinct forms: One in vomiting and purging, presenting something of the symptoms of cholera in the human system. In another, severe constipation; and in yet another, the symptoms of quinsy, without the swelling under the throat. And yet we call it all cholera!

It would be hard to enumerate half the medicines that have been tried and found wanting as remedies for this disease. But after all we know absolutely nothing of the seat of the disease or its causes. Those who have not "doctored" at all have fared as well as those who have.

The same remarks are applicable as to fowls; we have suffered much and learned nothing. I have talked with a number of our best-informed stock-men, and even with physicians, and find their theories differ so widely that I hardly think it worth while to give them.

Mr. JOHN HORNBACK, Carthage, Jasper county, says:

We have had no prevalent diseases among horses since the epizootic, four years ago, except the common horse or colt distemper, which seldom is treated with medicine or proves fatal.

There is and has been a fatal disease prevailing among the cattle of the county. It is known as Texas or Spanish fever, and is very fatal. During the past summer, whereever Texas or Southern cattle were herded nearly all the home or native stock of cattle died off. In some neighborhoods and settlements there are scarcely any cattle left. When first taken they appear to droop around for a day or two, looking very gaunt and hollow. They also have a hot fever, with little or no appetite. About the third day they appear to fail very rapidly, and in many cases do not live beyond the fourth day, and rarely if ever longer than the sixth. If examined after death the stomach or manifold, and the food contained therein, will be found as dry as dry light wheat bread, and the folds of the stomach will be about as tender as wet brown paper. There are many reported remedies for the disease. I have tried a great many of them myself, but have never succeeded in curing a single animal. I think the only preventive or remedy is to keep the Texas cattle away from our native stock. Our cattle never have the disease unless they run with or are grazed on the same pasture with Texas cattle.

For the past two years we have suffered to some extent with diseases among hogs. The disease is called cholera by many persons, but instead of but one I think there are many diseases. During last summer and fall a great many pigs and shoats died. Some would die in a very few days after being taken sick, while others would linger along and live for nearly a month. It is my opinion that most of the pigs and shoats that were lost died from the effects of worms. Soon after death a great many small worms would crawl out of the nose and mouth, and when cut open and examined the stomach and lungs would be found infested with large numbers of small, white, wiry-looking worms. I am of the opinion that some of the larger hogs died of the genuine hog-cholera, but I have heard of no certain remedy for it.

Nearly every summer a disease prevails among fowls in this county. I think the disease is what is generally known as chicken-cholera. We have no certain remedy for it.

Mr. ROBERT W. FRITTS, Lanes's Prairie, Maries county, says:

Cattle were quite healthy here until late in the fall, when a few cases of what is generally termed the blackleg occurred. There were some half-dozen cases in my neighborhood, all of which proved fatal. The animal generally lives from twenty-four to forty-eight hours after the attack sets in. Before death stiffness occurs in the hind parts, generally in one hip or leg; the head and ears droop, and dullness and stupor are observed. Fever, and a general quivering of the flesh, especially in the hind parts where the disease seems to be located, also are observable. After death the leg has a black or bruised appearance under the skin. Other parts seem natural except the gall, which appears enlarged. Several remedies were tried, but all failed to give relief.

We have a disease among hogs that has killed about 10 per cent. of them in this neighborhood. Some people term it cholera, some measles, and some lung-disease. It is first discovered by the hog refusing to eat and lying around in a stupid condition. Sometimes they will both purge and vomit, sometimes they will purge and not vomit, or vomit and not purge, and sometimes they will do neither. After death the neck and chest turn spotted, and the insides are often quite pied. Sometimes they appear nearly rotten; at other times nothing of an unusual character is observed. The duration of the disease is from one to three days, but occasionally a case will linger for a week. After recovery from the first attack, when attacked a second time, a cough sets in, and they usually die in a short time. Those that recover are hard to make thrive or look well again, so it is generally decided here that but little is gained by a cure. Several remedies have been tried—in fact nearly everything that could be thought of—but nothing has proved very successful. I had several hogs attacked, but lost none. I used turpentine as a remedy. I was compelled to drench some of them, but generally I was able to administer it in slops or over their feed. I told my neighbors of it, some of whom tried it and were successful, while others pronounced it a failure. I believe if used properly and in time it is not only a preventive but also a cure. From a tea to a table spoonful twice a day for two or three days is the way I administer it. The disease seems to be contagious, as it is generally from seven to nine days after it makes its appearance among a gang of hogs before others take it, and then dozens may be attacked within a period of twenty-four hours. Dr. Grace, who lost a hundred head by the disease, tried drugs, but finally gave the matter up and considered the malady incurable.

Mr. ALBERT BADGER, Nevada, Vernon county, says:

Last year this county lost many thousands of dollars in horses, cattle, and hogs,

and this year seems to be no exception, as the same diseases have prevailed to a greater or less extent every year for thirty years past. I believe this can be said of every county in the State. At least eighty head of horses have died in this county since October, 1877, from the effects of eating worm-eaten corn, and in all probability as many more will die before grass comes in the spring. It is true this loss can be avoided by carefully removing all worm-dust from the corn before feeding, but many never know the danger until too late. Others, boys and hired help, although often warned to be careful, are just the opposite. The symptoms of the disease are various; sometimes it results in blind-staggers, crazy fits, stupidity, and general prostration; sometimes they will sit for a long time like a dog. I believe, from the start they are partially blind. or entirely so. The disease has never been cured, and we sorely need an antidote for this worm-poison.

We also lose quite a large per cent. of horses every year by bots. The fly which produces this grub is very plentiful in prairie countries. Specifics are used which sometimes succeed in causing the worms to let go, otherwise the horse dies. I lost one of the finest animals in this part of the county during the past summer, within fifty minutes after he was attacked. One of my neighbors lost two last week, and so they go

The most troublesome disease among cattle, which yearly hangs to us, is blackleg, for which we have no preventive or cure. The disease is most prevalent and fatal among calves and young stock. It invariably attacks and kills the fattest and most promising calves, and leaves the poor and runty ones. Either a preventive or cure would save millions of dollars annually to the people of this State. I might as well state here that a drove of Texas cattle slipped through this county in September last, and left a disease which killed at least $2,000 worth of native stock. I lost five head of cattle myself by it, and I can say with all truth that we would all feel much safer if we had a remedy for this terrible scourge.

NEW YORK.

Mr. P. E. WHITE, Denmark, Lewis county, says:

A new disease made its appearance the past summer among horses, which is called spinal meningitis, and baffles all medical skill. In the last case which came under my observation the horse, to all appearance, was well in the morning but died before noon. The animal, when attacked, begins to droop very suddenly, refuses to eat, shows signs of pain, drops to the ground, and is never again able to rise. They usually lie flat on one side, and never seem to move a muscle even in the throes of death.

Colic, in its various forms, causes the death of more of our valuable horses than any other disease, and an effective remedy would be of great value to the owners of these animals. Various remedies have been prescribed for this disease, but they often fail. Colic terminates one way or the other in a very few hours, and therefore requires speedy and careful treatment.

We do not know of any prevailing disease in the herds of our county except that of abortion among cows. This direful scourge and fearful drawback to the dairying interests of this locality has been prevailing here for several years, and still continues with unabated progress. Thousands of dollars are yearly lost to the farmers by the ravages of this disease alone (we term it a disease, for we know of no other name to give it). We have known of large dairies where nearly three-fourths of the cows would abort, and yet no key has been found to unlock the mystery. It is well known that large sums of money and much time have been expended to solve this mystery without arriving at the true cause or source of the trouble. We would therefore recommend that abortion in cows is one of the diseases marked for a special and thorough investigation by your department. The welfare of the farmers and stock-growers of the country demands this.

In swine there has been more or less mortality the past season, especially among pigs from one to two months old. We have known of nine or ten pigs of that age to die one after the other, and all apparently of the same disease. The first symptom noticeable is a loss of the use of the hind parts. They commence to drag their hind legs after them, refuse to eat, and usually die within a few hours. Sometimes when affected with the disease they will give a squeal and drop dead without further ceremony. No remedies, so far as we can learn, have been administered for the arrest of the disease. Some call it a disease of the kidneys, but we are not prepared to state what it is. We only know it cleans out a pen of hogs (it prevails also among grown hogs) in double-quick time.

NORTH CAROLINA.

Mr. S. V. PICKENS, Hendersonville, Henderson county, says:

In this locality, where the atmosphere is mountainous and the water pure, the most of

the ills to which horses are liable are, either directly or indirectly, the result of mis treatment, except, however, the epizootic and other distempers, not very prevalent at any time in this section. Among the most commom diseases here are the gravel, scours, glanders, and colic.

In case of gravel the horse manifests great pain; when standing will stretch his legs far apart; when lying the animal rolls much upon his back. When thus affected the horse must be relieved in a few hours, or death will ensue. As a remedy, take two eggs, pour out the yellow through a small hole broken in the shell, then fill the shell with spirits of turpentine, and make the horse swallow the whole. Some inject onion juice up the water-organ with good results.

Scours are generally caused by excessive exercise or over-feeding with green food. This causes over-heating, which is followed by loose discharges from the bowels, producing general debility accompanied with great suffering. A dose of spirits of turpentine or tar ooze will generally relieve the animal by checking excessive discharges, after which drench freely with warm sage or pennyroyal teas.

Colic may be caused by excessive work, irregular and excessive eating, drinking, &c. It is indicated by the strongest manifestations of pain, great restlessness, continual walking, rolling or pawing, and body swollen. The most speedy cure known to us is to "rake" the animal and bleed in the neck and mouth. Then give him freely ot warm teas by drenching, with soda dissolved in it. This disease does its work usually in a few hours.

We believe most horses have bots in them, but that their ravages are seldom committed upon an animal when in good health. Therefore, when a horse is debilitated and his whole organization deranged by disease, is when the bots begin their work. This is known by the great restlessness of the horse, and the resting of his nose upon his flank. One-half pint each of whisky, lye, sweet milk and molasses well mixed and poured down the horse in time, is almost a sure cure, but should be followed in one hour by one-half pound of salts, to be repeated if ineffectual. These remarks have special reference to this immediate locality, but are alike applicable to the mountainous region of western North Carolina.

Before closing my statement relating to horses, let me advise the free use of salt and lime, or wood ashes, mixed in food. It serves as a preventive for many of the diseases common among domestic animals of this section.

Our cattle seldom die of disease, save the "hollow-horn," more justly called "hollow belly," since the latter is generally the cause of the former; and distemper, believed to be contagious and almost invariably accompanied by what we term the "distemper tick," great numbers of which get upon the cattle about the time and in localities where the disease rages. It is thought to be communicated by grazing where affected cattle have lain or grazed. It is also said that a cow may have it in its system and communicate it to others and show no symptoms in themselves. The free use of sulphur internally and kerosene oil externally serves as a good preventive, in which alone is safety.

Hogs are sometime affected with cholera, which is supposed to be transmitted from one to another. So very fatal is this disease that perhaps 80 per cent. of the hogs attacked with it die. Tar and copperas are good preventives, used in food. Kerosene oil and blue stone are as good remedies as we know of here.

Mr. James W. Terrell, Quallatown, Jackson county, says:

Here in the mountains of western North Carolina, by far the greater part of the income of the people is derived from the sale of horses and cattle, particularly the lat ter, while hogs, sheep, and poultry contribute in a smaller proportion. As we work our horses and mules while young, and sell a large proportion of them after maturity, it is only in rare instances that one ever dies. The epizootic swept along in the fall of 1872, but by the time it reached us it had assumed so mild a type as to do but little harm, and it has not since reappeared. Our young horses sometimes have something like influenza, but it seldom proves fatal, the animals recovering without treatment. What is known as "bots" or "grubs" is the only really formidable disease that attacks the horse here. The symptoms are restlessness, loss of appetite, the eyes appear weak and the whites enlarged, or more apparently visible, the gums and lips pale and clammy. The animal frequently turns his head toward his flank, lies down frequently, but does not roll as with colic. As a remedy I can scarcely think of anything in the whole veterinary practice that has not been recommended. Sage-tea followed by a purgative, sweet milk and molasses, spirits of turpentine, a bluestone pill, are among the most commonly-applied remedies. I look, however, upon a copious drench, say a quart, of a strong decoction of the common garden tansy as the most efficacious. I do not give it as a specific, but I have not yet known it to fail, if given in the early stages of the disease. As a preventive, keep a cloth saturated with hog's lard in the stable during the months of August and September, and occasionally or daily rub the horse lightly with it over the parts where the "bot-fly" deposits its eggs or nits on

the hair. These nits by some means get into the horse's stomach, and hatching there produce the grub. Grease kills the egg and prevents its hatching.

Hogs have cholera, or a disease which we call cholera, that in the last two years has cut our hogs down below the demand for home consumption. The symptoms are loss of appetite, disinclination to move, vomiting, diarrhea, eruption of the skin, loss of hair, and, of course, great loss of flesh. It is very fatal, killing, I think, over half the animals it attacks. It seems to be epidemic. I do not think it is contagious. What causes it? A writer in Illinois—*vide* Country Gentleman—says an exclusive corn diet; but here it attacks equally our hogs in the wild mountain range with those raised on the farm, those fed on kitchen-swill, garden-vegetables, or by a mixture of all these things. It also attacks all breeds from the Berkshire down to our native razor-backs, and all the intermediate grades. We have no remedy. A good many things have been tried, and sometimes the animal gets well, but I believe as large a proportion without as with treatment. My own experience, corroborated by that of some of my neighbors, is that a plentiful supply of fresh wood-ashes and charcoal, with a little salt, kept where the hogs will have continual access to it, is a preventive. One would be surprised at the avidity with which they will eat this mixture. I lay great stress on this preventive, for I do not remember that I ever had an animal attacked with the disease when it had been supplied with the mixture, and, as a verification of the adage that "an ounce of prevention is worth a pound of cure," I have never had a hog to recover from the disease.

We also have chicken-cholera, but I know neither remedy nor preventive. I only know the chickens refuse to eat, droop a few days, and die. A neighbor tells me: "Feed your chickens on dough made of corn-meal and soft (lye) soap and they will not have the cholera." It is simple and worthy of trial.

Mr. JAMES H. RUMBOUGH, Warm Springs, Madison county, says:

Among some farmers of this section cholera sometimes prevails to the extent of destroying all the hogs on the farm. I have, however, never had a case, using as a preventive a weak solution of concentrated lye. I cannot learn of any intelligent remedy that is employed in this immediate section, and, having had no experience myself with sick hogs I am unable to suggest a remedy, or present any peculiarities of the disease, as I am not at all acquainted with the symptoms of hog-cholera. But I am of the opinion that the disease in this climate is solely attributable to want of proper care and intelligent attention, over and irregular feeding, exposure to inclement weather, filthy quarters, want of salt, in the absence of which latter the animals sometimes resort to dirt and the accumulations in their pens.

The chicken-cholera is sometimes prevalent here among that class of fowls which is the staple poultry of this section. I have no experience of any value in regard to this disease, and no suggestion beyond the want of proper care and attention on the part of a rustic population who have no idea as to the importance of attention, proper food, protection from the weather, provision of proper gravel, or cleanliness of roosts and quarters. Being a country of prolific vegetation, and the fowls being allowed to run at large over the farms, the young ones are subjected to the damp and cold of the dews and rains, which superinduce diseases peculiar to young chicks.

I am of the decided opinion that in a climate like this, naturally free from epidemic diseases to man and beast, that care and attention, intelligent regard to the comfort and food of animals, will constitute good, effective, and sure preventives of diseases of all kinds among animals and fowls.

Mr. JAMES M. MAYO, Whitaker's, Nash county, says:

In response to your circular letter of the 10th instant, I report as follows:

Horses.—One-half of 1 per cent. are subject to what is known among the planters as "staggers." The animal seems sluggish and sleepy, eyes dull and sunken, ears cold, and pulse quickened. This continues from two to four days. The animal, at intervals, suddenly starts and walks, or rather staggers around in a circle, with head down. Of those affected, 99 per cent. die. It is noticed that there is more of this disease when we have a rainy spring than when the reverse is the case. The writer has cured one case. I drenched the animal with a solution or decoction of red pepper and salt once each day, and cut the forehead about two inches above and between the eyes, then running the blade of the knife down and up loosened the skin, thereby getting up a counter-irritation. I know of another horse cured by a similar process. I think this disease is due in a great measure to defective forage, bad and early grazing, when the animals are not accustomed to it—in short, when the planter, in anticipation of a short crop, desires to economize in feed and stints his animal. In 1867 we had an unusual amount of rain and bad crops, and the death-rate by staggers was fearful. In Hyde county the rain-fall has been very great, and hence crop prospects exceedingly poor, and the fatality this season has been much heavier than usual, as doubtless you have seen from the reports from that county. I state this much to show that with judicious management this fatal disease might be avoided. We also have the snuffing epizootic,

that "comes on the wings of the wind." I use, and have seen used with good effect, carbolic acid, pine-tar, and other disinfectants. We have, in isolated cases, other diseases as cited in the books, and used the remedies as suggested, with the ordinary per centage of failure and success.

Cattle.—We can almost say our cattle are free from disease. We give them no care at all, even in winter, and what few die is the result of old age or starvation. The same may be said as regards sheep. There are but few in the county, and they take care of themselves.

Hogs.—Cholera, as we know it, is the disease that promises to make the raising of pork difficult in this country. The animal is taken with vomiting and running off of the bowels, no disposition to eat, general languor and listlessness. Of the old (one year and over) affected, 35 per cent. die; of the young pigs and shoats, 95 per cent. die. I do not think that the disease, once in the sytem of the boar or sow, ever leaves it entirely; for upon the sow having pigs again she will either have very few, or what she does have will soon die with this cholera.

Remedies.—1st. Put a small quantity of spirits of turpentine on the corn or in their feed three times each week or oftener, as it will do no harm. 2d. Feed all the slops and swill-feed you can, in which put saltpeter, red pepper, and salt. 3d. Keep salt at all times where the hogs can get all they want, and, by the way, keep it where all the animals can get at it at all times.

This dreadful disease was almost unknown in the days of our forefathers, and I have almost arrived at the conclusion that the raising of cotton has bred it. It is known that the eating of cotton-seed by hogs while the seed are in the process of fermentation will certainly kill them; and this, in my opinion, has brought about the disease. But the question is asked, "How does the cholera get up in Iowa and the Northern States, where they raise no cotton?" They buy the oil-cake, which is made of cotton-seed, and feed it to their hogs. A small percentage may die from eating poisonous mushrooms, but I do not believe that many die from that cause. On one of my plantations, on which I have raised a great number of hogs, I never knew a case of cholera, or any disease, until this year, when I lost between fifty and sixty pigs. The reason was this: My superintendent had made a compost-heap in which he had put a large percentage of cotton-seed, and the hogs had free access to it. So soon as the seed commenced to rot, the hogs eating them were taken with the cholera. If the farmers of the North will keep their hogs from cotton-seed and oil-cake, my word for it they will never be troubled with cholera.

Fowls.—We denominate the main disease with them here "cholera." The fowl droops for a short time, and then commence spasms, from which they soon die. They are found dead under the roost and about the yard. I think this disease is partially due to inattention. The loss from cholera is about 5 per cent. For a remedy, feed them on small grain in moderate quantities. Mix in dough and feed once a week, or as the flock seems to need it, alum, red pepper, onions, and copperas. Keep marl or carbonate of lime where they can get it, and they will eat as they need it. Turkeys, ducks, geese, and peacocks are quite healthy, and I never knew one diseased.

OHIO.

Mr. JAMES M. BURT, West La Fayette, Coshocton county, says:

I can say that, during a residence of near half a century as a farmer in this county, with few exceptions the cause of disease among and loss of farm-animals has been the result of neglect and improper treatment. Notwithstanding the best of treatment, however, the epizootic prevailed for a time among horses; and what is known here as "colt distemper" frequently prevails, which, if not properly treated, terminates in glanders, an incurable disease. My treatment, which proved effectual, was saltpeter dissolved in hot water, mixed with wheat-bran mash and fed warm with oats or chop feed—one ounce per dose every third day.

No contagious or fatal disease has prevailed among cattle in this vicinity. Feeding at regular hours in winter, with free access to water and salt at all seasons, has been my system, and I have lost none from disease.

Grub in the head has prevailed among sheep. The disease is incurable, but it may be effectually prevented by giving them salt mixed with dry wheat-bran as often as once a week during the summer and fall months, when the fly abounds which causes the disease. The same treatment will prevent the disease commonly called "rot," or cure a cold contracted by exposure or sudden changes of the weather. I am not familiar with the foot-rot or scab, as it has not appeared in this vicinity.

The cholera, kidney-worm, and other diseases that hogs are liable to in some localities are effectually prevented by giving them free access to the slack or waste from our bituminous-coal mines, which abound in this vicinity. Copperas and sulphur are its component parts. I have never lost a hog from disease.

In-and-in breeding is believed to be the cause of all the diseases that fowls are liable

to. Since we have annually marketed or exchanged all our own raising of males and kept our hennery cleanly whitewashed and the floors covered with lime, we have lost no chicks or grown fowls from cholera or any other disease.

Mr. A. H. WRENN, Mount Gilead, Morrow county, says:

There has been a slight return of the epizootic among horses this fall, accompanied with a slight cough and a little discharge from the nose. But little medicine was given. Bran mashes and other laxatives to keep the bowels open, with a little extra care, have restored them to ordinary health.

Sheep are affected with foot-rot, scab, and what is known as grub in the head. A good many remedies are used, sometimes with success and again without any apparent effect.

We sometimes hear of a few cases of thumps and cough among hogs, and now and then a case of blind staggers, but few deaths are reported. Charcoal, ashes, salt, and even soft-soap, are used as remedies, especially when cholera prevails among hogs.

Thousands of chickens die annually from diseases incident to fowls. Many families lose large flocks entire. Wild-cherry and white-oak bark, dog fennel, and red and black pepper are used as preventives and remedies. The most successful treatment of late is a small quantity of asafetida in water, blue mass in very small pills, and a little blue ointment on the head.

PENNSYLVANIA.

Mr. J. S. ELDER, Darlington, Beaver county, says:

Sheep are the only class of farm-animals subject to any specific disease, and the most troublesome one is that known as "pales." The remedies are turpentine and copperas mixed with salt and placed in boxes in their feeding-places. But I find they never recover their former health. They dwindle away for a year or two and then die. I find it almost useless to try to save them. Foot-rot also prevails to some extent among sheep. About the only remedy used is sulphate of copper.

Two horses died in this neighborhood a few days ago. They were sick but a few hours, and during this time walked around with their heads down and ears drooped until they fell down dead. We have no veterinary surgeon in this vicinity, and therefore I can furnish you with no diagnosis of the disease.

A great many cows annually die here with puerperal fever. There seems to be no remedy for the disorder.

Mrs. J. S. YOST, Pottstown, Montgomery county, says:

We have had some cases of pleuro-pneumonia among horses in this section of the county. Symptoms: The animals lag in their walk, and manifest little desire for food. They have a cough, with discharges at the nose and mouth. The remedy used is forty drops of aconite and eighty drops of muriate tincture of iron in water, given twice a day. The animal should be well rubbed. I am informed by a veterinary surgeon that horses afflicted with the epizootic five years ago are more liable to this disease than others. The disease is quite fatal. Some horses live but a few days, while others may linger for several weeks. If proper remedies are immediately used two-thirds will recover. A *post-mortem* examination reveals the pleura in a high state of inflammation, presenting a purple-red color. The blood is watery, and about the lungs is found pus.

A few cattle have also had pleuro-pneumonia. The symptoms are about the same as in horses, with the exception that the cough is harsher. Twenty-five drops of aconite and fifty drops of muriate tincture of iron in water, given three times a day, is the remedy used.

There have been some cases of hog-cholera in this locality. When attacked the animals swell and turn purple about the jowls, and have a white appearance about the nose and mouth. If not immediately attended to they will die in three or four days. Aconite in water (twenty drops) is used as a remedy. If the hog does not vomit within two hours, ten drops more should be given. Rub the neck and jowls twice with an ointment made of four ounces of iodine mixed with one pint of lard.

Chicken-cholera has prevailed here for several years past. They often die before you are aware that there is anything the matter with them. When attacked they refuse food, the comb becomes very dark, almost black, as does the flesh after death.

TEXAS.

Mr. GEORGE H. JUDSON, San Antonio, Bexar county, says:

The facility with which horses and cattle are raised here, without any care other than marking and branding, has bred a carelessness among farmers and stock-raisers

that is truly deplorable. Trusting to nature entirely to provide food for their stock, when a cold winter follows a droughty summer, thousands of cattle and many horses die of starvation. The introduction of railroads has brought a new class among us, and they are bringing a better grade of cattle with them. Lands are being fenced and stocked, and some care is beginning to be observed in the treatment of farm-animals. Whether disease will follow is yet to be determined.

I have been a raiser of sheep for several years past. The only disease seriously affecting them here is apoplexy. Our oldest and fattest animals are generally the ones to suffer. From a small flock of five hundred and forty I this year lost one hundred and ten head, nearly all of which were wethers and excessively fat. There are no previous symptoms. To an inexperienced shepherd the sheep appears remarkably well, and apparently very happy, often frisky, when he suddenly makes a leap into the air, falls, and in less than three minutes' time is dead. This disease only occurs in excessively hot weather when water gets low, or when they have to be driven some distance to water. I have heard of no remedy of any value. Some starve their sheep by keeping them in their pens until eight or nine o'clock in the morning, and then folding them early in the evening. This may do, but I doubt it.

Last fall we had a new disease among chickens. Something like a pimple or wart appeared on the heads of the young chicks, and after a few days the chick would lose its sight, and then wander aimlessly around untili t starved to death. These warts made their appearance on the eyelashes and about the bills. Copperas-water was freely used, and all the adults saved, but the young chicks were not benefited. In fact, they were not much cared for, as they were a cross between the common fowl and Brahmas. Had it occurred among the full-bloods, in all probability they would have been saved. In all other respects the chicks were in good health, as they had an excellent appetite.

Mr. M. W. Wilmeth, McKinney, Collier county, says:

Among horses, we have all the old diseases known to farriers, such as bots, colic, &c.; but our most fatal local disease is known as blind-staggers. An attack of this disease, on an average, lasts about twelve hours. The animals, so far as my observation enables me to judge, always die of the disease. Boring into the lower part of the forehead, between the eyes, has been tried, but without success. All other remedies have alike proved abortive. Spanish fever also prevails at times. The animal has fever, and is much affected in the loins; lingers sometimes months before dying. In some cases the disease is cured by bathing the loins in strong brine. This disease is not so common as formerly.

We have, among cattle, the common diseases known as bloody and dry murrain, both of which may be cured by purging the animal with rhubarb. This disease proves very fatal unless attended to in time, say within twenty-four hours after the attack. We have, also, what is known as Spanish fever. The animal is taken with a high fever, is much affected in the loins, and has short breathing. Cured by using a strong tea made of Jamestown weed, either of the seeds or leaves, and drenching the animal with a quart.

We have had cholera here recently among our hogs. It is a thing of late date with us, and is always fatal, as no cure has as yet been discovered. We also have among our hogs a kind of lung fever, which is very destructive. It makes its attack like Spanish fever among horses and cattle. Some cases have been cured by the use of calomel and arsenic.

Among fowls we also have what is known as cholera, though this name seems to be applied to all diseases among chickens. Alum, copperas, &c., are used with some effect.

Mr. James H. Swindells, Lancaster, Dallas county, says:

We have not been troubled with diseases among any of the lower animals except among hogs and chickens, both of which were, and now are, affected with what is termed cholera. Until a year ago the hogs in this locality were not affected with cholera. The disease was brought here by the importation of stock from Wise, Montague, Parker, and Johnson counties, a tier of counties lying in the lower Cross Timbers, west of this point. When they arrived they were herded with hogs raised here. In less than a week the imported hogs became diseased and commenced dying rapidly. The affected ones were separated from the others and various remedies were made use of to check the disease, and, if possible cure it. None of the remedies used seemed to be of any benefit, and nine-tenths of those affected died. The disease soon spread to the native stock, and since then (last fall) there has been more or less of the disease present.

The symptoms observed are as follows: Indisposition to move about or to eat; lying down most of the time; diarrhea, with excrements first of a natural character, but gradually getting darker until the evacuations become almost black; fever, the temperature in some cases running up to 108° F., but generally to about 102°. Before

death the animal would vomit a dark-green or black fluid, swell up, and the odor emitted would be very offensive.

The only effective way of checking the disease would seem to be to separate the diseased animals and put them into a clean lot having running water in it. I had a few hogs which were taken sick with this diarrhea. In a day or two the discharges became of a light-green color, and very thin. I relieved all of them but one (I believe seven were attacked) by the administration of calomel. For a hog weighing one hundred pounds I would mix one dram of calomel with a handful of meal and a little milk, and let them have that much in the course of twenty-four hours. They would generally eat a little at a time until the whole is disposed of. The calomel did not seem to purge. On the contrary, the bowels would check up, and in from one to two days the animal would commence eating corn and would get well without any further trouble. The one which died would not eat the meal in which the calomel was mixed.

Mr. W. A. Trobinger, Whitesborough, Grayson county, says:

Cattle are very healthy, except those imported from Missouri, Illinois, Kentucky, Ohio, &c. These are nearly all attacked with a fever within one or two months after their arrival, and at least one-half of them die. The symptoms are high fever, costive bowels, loss of appetite, and general listlessness. The duration of the disease is from one to two weeks. Remedies are various, but none very successful. *Post-mortem* examinations usually show signs of enlargement of liver and spleen, with inflammatory action of stomach and bowels. We have no reliable remedy.

Hogs have been very liable to disease for five or six years. Almost every disease that attacks animals of this class is pronounced cholera, but I have seen but few cases that could legitimately be thus called. The symptoms of the majority of cases that have come under my observation seem to be something like the disease called "quinsy," a swelling of the glands of the jaw. The duration of the disease is usually only a day or two. The remedies are such as calomel, scarification of affected parts, nux vómica, and even strychnine.

We are very much troubled with disease among all kinds of fowls, which, I think, is well named cholera. The symptoms are excessive purging of the bowels and loss of appetite. They die within one or two days. The remedies are as various as the whims of men. The most successful that have come under my observation are madder, capsicum, calomel, and the mineral acids. Nitro-muriatic acid has considerable reputation as a preventive. Dose from one to two drops.

Mr. Jo. Abbott, Hillsborough, Hill county, says:

1. I will say that my observation, which is supported by information I get from several well-informed gentlemen, is, that horses and cattle which run at large on our prairies are entirely free from disease of any kind.

2. That horses which are kept up for use are sometimes troubled with bots or colic. These cannot properly be said to be diseases, but instances of these complaints are rare. For the first, a drench made by dissolving about one-third of an ounce of bluestone in water sweetened is regarded as a specific. For the latter one-half pound of bicarbonate of soda dissolved in water is frequently used with good effects. In violent cases this is repeated once or twice.

Hogs are frequently affected with cholera, which at times assumes the form of an epidemic among them. In seasons of this kind the loss is often 50 per cent.; but I will say that I have known of no cholera among hogs during the past twelve months. I am not informed of a remedy for this disease, although several experiments have been made.

Fowls, especially chickens and turkeys, are frequently visited with cholera. I have never known a fowl to be cured after the disease was fully developed, though many trials have been made. My observation is that if fowls are fed on onions, mixed with other food, or if you can induce them to feed on the onion while growing, as they sometimes do, they will never have the disease. I believe the onion to be a sure preventive.

Mr. G. W. Johnson, Humboldt, Hunt county, says:

Blind-staggers in horses is perhaps the most fatal disease we have here. The remedy is to bleed freely from the neck, taking enough blood to cause the horse to show signs of faintness. Then give a drench composed of a tablespoonful each of spirits of turpentine, ammonia, and camphor, with about a pint of milk-warm water. Always drench through the mouth—never through the nose. Then burn tar, feathers, woolen rags, scraps of old leather, &c., under the nose. If this treatment is given nine cases out of ten will recover, if the horse is able to stand upon his feet when it is commenced.

Both dry and bloody murrain are very fatal to cattle in this vicinity. The best

remedy for the first is a strong tea made of the common may-apple root, and for the latter saltpeter and guaiacum.

Cholera is the most fatal disease affecting hogs. The best remedy we know here is equal parts of guaiacum and copperas and Jerusalem oak seed, say a tablespoonful of each, mixed in slops sufficient in quantity for five or six head of hogs. This has proved a good preventive as well as a cure.

Cholera is also fatal among all our domestic fowls. The best remedy I have tried is pulverized mustard-seeds. No particular quantity is prescribed, but it should be given freely. It will be found a cure as well as a preventive.

Mr. Arthur V. Wadgynear, Castroville, Medina county, says:

Our horses are, in general, very healthy, and I have noticed only two prevalent diseases, viz., bots and distemper. The bots are produced by two different insects, *Gastrophilus* and *Chrysops metallicus*, which deposit their eggs on the hair of the horse, on the breast and fore legs mainly, and are bitten off and swallowed by the animal. They are carried into the stomach, where they remain until the following spring, when, having attained their full size as larvæ, they are carried along the intestines and evacuated. The symptoms of a horse afflicted with bots are uneasiness and apparent pain in the bowels. The animal falls to the ground, starts up again suddenly, paws with the fore feet, and so on until exhausted. Remedies are numerous, but I have found only one which never failed. It is as follows: Mix six ounces of Epsom salts with a pint of a strong decoction of worm-seed herb (*Chenopodii Mexicani*), say eight ounces of the weed to one quart of water, boiled down to a pint; then mix with this solution about four ounces of oil of turpentine; put in a quart bottle, and drench the horse well with it. At the expiration of an hour give the animal a half pint of linseed oil, which will soon cause the expulsion of the worms or bots.

The symptoms of distemper are, loss of appetite, swelling of the glands of the jaw and under the belly, slight fever, cough, and discharge from the nostrils. If these symptoms do not abate, emaciation, general debility, and death soon ensues. The following remedy is used: One-half ounce black sulphate of antimony, one ounce muriate ammonia, three-fourths of an ounce of saltpeter, four ounces powdered gentian-root, and two and one-half ounces of powdered *fœnum græcum* seed, mixed, divided into eight doses, and given three times a day. The animal must be kept in a dry, warm stable, where no other horses can come in contact with him. The disease generally yields within from five to seven days.

The only disease which affects cattle to any considerable extent in Western Texas is "hollow-horn," or "horn-distemper." The cause of this disease is a "hollow-stomach" and an insufficient supply of wholesome food. The symptoms are gradual decay of the pit of the horn, loss of appetite, sluggishness, swelling of the eyes and head, cold horns, urine bloody, costiveness, and swollen udder. The remedy is one-fourth pound each of powdered ginger and gentian-root, one ounce of saltpeter, and two ounces of ammonia, mixed well, and a tablespoonful given three times a day in food. If the disease is of long standing, remove the purulent matter, either by sawing off the ends of the horns or by boring them with a large gimlet. The hollow should be kept well cleaned by the injection of a solution of carbolic acid, soft-soap, and water; say one ounce of carbolic acid, four ounces of soap, and one quart of water. In the early stages the disease may be cured by a generous feeding of corn-meal and good grass, and the application of the above solution to the head and neck.

The "wolves" is a disease caused by a yellow, grayish-looking fly, of a species not known to me. It deposits its eggs under the skin above the hoof of the animals. In a few days it hatches, and the mite migrates all over the body, and finally lodges itself under the skin, where it grows and undergoes its transformation as a larva. It then bores through the skin, emerging as a perfect "heel-fly." These flies appear early in the spring, and cause the death of thousands of cattle. No remedy is known.

There is no Texas or Spanish fever among cattle in Western Texas. Ticks are plentiful, but they do no harm to native stock.

Mr. James Bowlden, Will's Point, Van Zandt county, says:

Most horses, but particularly young stock two years old, are, in the winter and spring of the year, attacked with a disease similar to the epizootic, and many stock-raisers think it one and the same disease. It is generally known here, however, as the distemper. The symptoms are cough, swelling of the glands of the neck, and a profuse discharge from the nose of a thick, green-colored matter. It is sometimes fatal but rarely so, and the animal often recovers without any help. All that seems necessary is good warm stables and careful feeding. Spanish fever attacks many animals brought in from other States. All imported animals are subject to this disease until they become thoroughly acclimated.

Cattle are subject to a disease called murrain, which generally proves fatal. Various remedies have been tried, but with little success. Imported stock (short horns) are subject to a disease called by some Texas fever and by others Spanish fever. The dis-

ease is very fatal, as but few animals survive. No satisfactory treatment or remedy has been found.

Hog-cholera seems to be more fatal than any other disease affecting farm-stock. The symptoms are loss of appetite, blindness, dullness, and weakness in the loins. Kerosene-oil and turpentine have been used quite successfully as a remedy when administered during the first stages of the disease. Many suppose the cause of the disease is from worms in the kidneys, as these organs are found, after death, to be more or less affected. Chicken-cholera is also quite prevalent and fatal. We have no preventive or cure.

UTAH.

Mr. William Bringhurst, Springfield, says:

The climate and natural grasses of the Rocky Mountains are well adapted to stock-raising, containing elements that are health-producing and in their natural state an antidote for most diseases that stock are subject to. The epizootic, when raging here, was not fatal to animals running at large. The horse, however, when domesticated, is subject to two very serious distempers, which, if not promptly attended to, will prove fatal, the most common and serious of which is called the cramp-colic, produced by change of and over-amount of feed. The symptoms are restlessness, enlargement of abdomen, accompanied with severe pain. It will prove fatal in four or five hours. The most successful remedy used is one-half pound common sal-soda, two tablespoonsful of ground mustard, and one tablespoonful of cayenne pepper, mixed in water and given to the animal. The dose should be repeated in thirty minutes. Two doses are generally sufficient.

In Mountain Farcy, the cause of which is not known, the symptoms are a swelling under the belly, which extends rapidly over the whole body. I have seen the head swollen to such an extent that the animal was blind. It is very difficult to arrest unless taken at an early stage, and will prove fatal in a few hours. The remedy is bleeding in the neck. If the limbs are swollen bleed in each foot, striking the plate vein on the quarter between the hair and hoof. One-fourth pound of aloes, divided in three doses, as pills, or used as a drench, and given every hour, in addition to above treatment.

Horned stock has not been subject to any contagious disease in these parts, although there are isolated cases of hollow-horn, dry murrain, and fouls, which seldom or ever prove fatal. Cattle thrive well on the mountain grasses summer and winter, and require but little care. The raising of sheep is attracting much attention and has attained considerable importance, and under the management of scientific men is becoming very profitable. The Spanish merino is acknowledged to be the best adapted to this region. The only distemper in sheep that we are troubled with is the itch or scab. For this we employ the following remedy: After shearing dip the sheep at least every other year in a strong solution of tobacco and sulphur, composed of one part of sulphur and five parts of tobacco.

Statement showing the number of swine raised in 1,193 counties of the United States in 1877, the number lost by various diseases and the value of such losses; also the value of all other classes of domesticated animals lost by disease during the same year.

Names of States and Territories.	Total number of counties.	Number of counties reported.	Number of hogs raised annually in State.	Number affected with various diseases.	Proportion of these attacked that die.	Money-value of losses.	Money-value of annual losses of all other classes of domestic animals.	Total value of annual losses of all classes of domestic animals.
Alabama	66	25	307, 250	56, 810	.5877+	$117, 240	$234, 550	$351, 790
Arizona Territory	6	2	1, 850	......	......	......	......	......
Arkansas	74	25	281, 804	74, 863	.6772+	184, 095	129, 400	313, 495
California	52	17	183, 789	5, 110	.5925	12, 175	78, 490	90, 665
Colorado	29	9	10, 635	......	......	......	23, 300	23, 300
Connecticut	8	7	74, 748	1, 220	.6611+	10, 974	49, 870	60, 844
Dakota Territory	43	8	17, 500	150	.4375	625	8, 898	9, 523
Delaware	3	2	20, 000	1, 000	.7166+	4, 500	8, 000	12, 500
Florida	39	18	105, 069	21, 400	.5738+	47, 855	82, 740	130, 595
Georgia	137	17	490, 131	85, 223	.5861+	230, 396	304, 655	535, 051
Idaho Territory	10	......	......	......	......	......	......	......
Illinois	102	68	2, 560, 406	520, 853	.6828+	1,789, 839	611, 337	2, 401, 176
Indiana	92	54	1, 553, 406	356, 222	.7019+	1,526, 539	513, 840	2, 040, 379
Indian Territory	9	1	......	......	......	......	......	......
Iowa	99	72	2, 142, 248	221, 158	.6375	1,884, 175	440, 165	2, 324, 340

Statement showing the number of swine raised, &c—Continued.

Names of States and Territories.	Total number of counties.	Number of counties reported.	Number of hogs raised annually in State.	Nnmber affected with various diseases.	Proportion of those attacked that die.	Money-valley of losses.	Money-value of annual losses of all other classes of domestic animals.	Total value of annual losses of all classes of domestic animals.
Kansas	84	40	694, 296	75, 840	.5774+	229, 665	220, 290	449, 955
Kentucky	116	31	596, 681	118, 163	.6842+	412, 403	301, 487	713, 890
Louisiana	58	17	209, 542	12, 620	.5250+	33, 483	77, 700	111, 183
Maine	16	11	46, 767	730	.4528+	4, 750	47, 532	52, 282
Maryland	23	14	202, 972	13, 595	.6583+	55, 170	120, 525	175, 695
Massachusetts	14	3	27, 600	370	.3900	2, 620	5, 850	8, 470
Michigan	77	43	401, 127	11, 013	.4911+	49, 560	319, 625	369, 185
Minnesota	76	39	200, 826	2, 245	.5758+	7, 985	100, 207	108, 192
Mississippi	75	36	340, 304	46, 515	.6434+	129, 166	411, 665	540, 831
Missouri	114	66	2, 254, 933	456, 416	.6757+	1,410, 005	433, 764	1, 843, 769
Montana Territory	10	3	3, 300	25	....	....	1, 000	1, 000
Nebraska	65	25	234, 294	31, 160	.6525+	128, 925	82, 269	211, 194
Nevada	14	1	1, 000	150	.9000	1, 300	4, 300	5, 600
New Hampshire	10	4	12, 771	275	.4233+	2, 200	34, 100	36, 300
New Jersey	21	3	11, 000	240	.8500	2, 170	16, 720	18, 890
New Mexico Territory	13	3	26, 000	1, 240	.7000	2, 500	17, 000	19, 500
New York	60	26	270, 786	10, 387	.3901+	32, 210	165, 934	198, 144
North Carolina	94	49	650, 048	143, 024	.5795+	430, 475	191, 944	622, 419
Ohio	88	62	1, 740, 388	26, 390	.5939+	506, 338	334, 608	840, 946
Oregon	23	10	43, 445	....	....	485	26, 000	26, 485
Pennsylvania	66	39	635, 387	22, 871	.5916+	112, 999	155, 000	267, 999
Rhode Island	5	2	11, 848	30	.7500	300	....	300
South Carolina	32	15	133, 891	22, 915	.6058+	60, 100	64, 300	124, 400
Tennessee	94	51	944, 106	176, 816	.6170+	491, 315	311, 550	802, 865
Texas	154	61	666, 288	99, 574	.5102+	247, 969	477, 631	725, 600
Utah Territory	20	7	17, 690	65	.4166+	360	23, 350	23, 710
Vermont	14	10	63, 591	3, 029	.5237+	19, 085	42, 850	61, 885
Virginia	99	64	741, 325	61, 680	.5593+	174, 119	248, 544	422, 663
Washington Territory	24	5	6, 039	30	.2000	100	1, 450	1, 550
West Virginia	54	32	300, 553	36, 239	.6183+	68, 490	71, 500	139, 990
Wisconsin	60	40	694, 413	9, 622	.5668+	26, 461	137, 995	164, 456
Wyoming Territory	5	2	67	....	....	....	....	....
Total	2,447	1.193	19, 932, 114	2, 727, 278	.5894+	10,451, 071	6,932, 035	17,383, 106

DEPARTMENT CORRESPONDENCE.

The Department is in constant correspondence, not only with its regular reporters and agents, and with agricultural colleges and State and county agricultural societies throughout the United States, but with individuals in every section of the country, who make occasional calls for information and advice upon matters connected with the progress of husbandry. The foreign correspondence also is extensive, embracing communications with every quarter of the globe in relation to agriculture and kindred topics.

The Department, by means of this general correspondence, is kept well advised of the condition and progress of agricultural industries, both at home and abroad, while its means of usefulness are enlarged and extended to the various and increasing wants and interests of our farming population; and its duty is thus fulfilled of "acquiring and diffusing among the people of the United States useful information on subjects connected with agriculture, in the most general and comprehensive sense of the word."

The system of international agricultural exchanges, initiated by the Department, has been kept up with interest and profit, and the correspondence connected with it has elicited expressions of cordiality and

cheerful willingness on the part of foreign governments and individuals engaged in the promotion of agricultural science, to co-operate with this Department in effecting a mutual interchange of publications upon the general subject of husbandry, as well as of seeds and plants indigenous to the respective countries. The reports of the superintendent of the gardens and grounds of the Department and of the librarian will show the immediate results and illustrate the permanent value of these exchanges.

The domestic correspondence is increasingly interesting, as evincing the important fact that among the farmers and planters of our country there is a growing and earnest spirit of inquiry as to the most practical and economical methods of culture, the investigations and discoveries of scientists and others in regard to new and valuable products, and the improvements which genius, skill, and experience have developed in mechanical appliances. The character and extent of this correspondence will be indicated by a few notices which we subjoin of some of its more interesting and important features, embracing inquiries for information as to new and untried productions or methods of culture, and the responses which the Department has been able to give. In addition to the extended correspondence of this nature has been that, far more extended, which relates especially to requests for seeds. This portion of the correspondence has involved a large amount of clerical labor, and has not been conducted without difficulty, arising from the necessity of limiting or of declining altogether very many of the requests which, had the duties and means of the Department permitted, it would have been much easier and pleasanter to have responded to without restriction.

The correspondence of the Department with the agricultural colleges of the country is less intimate and complete than is desirable. These institutions and the Department of Agriculture are alike creatures of the government. The ultimate objects of both are the same, and the usefulness of each would obviously be advanced by the maintenance of such intimate relations between them as would give to each the benefit of the other's facilities of information and experience in its special and appropriate sphere of operations. The beneficent intentions of the government can only be realized through concerted or harmonious action, and such action must depend essentially upon a free interchange of views and a mutual communication of experiences and results.

TEXTILE PRODUCTS.

The utilization of fibers for textile purposes, which must exercise an important bearing upon the future industrial prospects of the country, has entered materially into the correspondence of the Department. Numerous requests for seed of the ramie and jute have been responded to, where encouragement was offered for faithful experiments, and climatic conditions were favorable. We have been obliged to advise our correspondents, however, in reference to these important fiber-plants that their final success depended very much, if not entirely, upon suitable appliances for manipulating and preparing them for market. Notwithstanding the large rewards offered by the Government of India and other foreign governments for a satisfactory decorticating machine, nothing has yet been produced of sufficient practical and economical value to meet the demand. The cultivation of these plants in this country is an established success, so far as conditions of soil and climate are concerned; but the commercial value of the products still depends upon the construction

of a machine which will fill all the requirements of cleaning and preparing the fiber so that it may realize its proper value in the market.

A correspondent of the Department in Coban, Guatemala, who has given much attention to the culture of ramie, in a recent letter makes some remarks on the subject of the much-desired decorticating machine, which we quote below, as containing suggestions that are of interest and value to all who are engaged in the culture of this plant. The Department, as is known, has noticed from time to time during the progress of its invention, improvements, and attempts at introduction, a machine invented by Mr. Emile Lefranc, of New Orleans, for separating and cleaning the fiber of ramie, jute, and other textiles. Mr. Lafranc has long been ardently and industriously engaged in the introduction and cultivation of ramie and jute in Louisiana, and has succeeded, upon a somewhat extensive scale, in demonstrating the practicability of successful culture; and his inventive genius has for a considerable period been employed in the construction of the all-important decorticating machine. At certain stages of his progress he has been so far encouraged as to express great confidence of final success. We are sorry, however, to find that the most recent, and probably most thorough, trials of his machine have demonstrated its insufficiency for the purpose. As a result of the offer of the India Government, a machine was invented by Mr. Greig, of Edinburgh, which upon being tested was found to come short of the required standard; but it was considered, nevertheless, so far hopeful as to be entitled to a reward of $7,500.

Our Coban correspondent, it may be, has suggested the true cause of these failures. He says:

> The cultivation of ramie will become a great interest as soon as a convenient machine is invented for the separation of the fiber. I believe the failure of so many inventions to be attributable to two causes: In the first place, the inventors had not personal knowledge of the qualities of the plant; secondly, they wanted to do too much; and not content with having secured a marketable production, they tried to bring the fiber out in a high state of perfection, which ought to be left to the manufacturer. A trial made at Philadelphia with Mr. Lefranc's machine has not been successful. I learn that the material used for that trial was *dried* stalks. Now, one of the most important desideratums for a ramie machine is that it shall separate the fiber from the *fresh* stalk, as it then produces a snow-white fiber, which remains white and glossy; while, if separated on the second or third day after being cut, the fiber becomes of a dirty yellow, dyed by the decomposed chlorophil, &c., dissolved in the juice, which is no longer circulating, but stagnating. This color renders necessary a posterior bleaching process by chemicals, which impairs the strength as well as beauty of the fiber, and makes the production more expensive.

It is a remarkable fact that in view of the extreme desirability of the machine in question, and notwithstanding the liberal rewards that have been offered for supplying the great desideratum, the object still remains unaccomplished. At first blush it would seem that the demand for a machine in the present case is neither more imperative nor more difficult to be met than was that which stimulated the inventive genius of Whitney and gave rise to the cotton-gin, and life and unbounded profit and importance to the culture of the cotton plant. We cannot but hope that a full realization of the advantages that must result from the cultivation of ramie and jute, will in like manner, through American ingenuity, secure ultimate success. Meanwhile, a statement is made, to which we are unable to give full credence, that Mr. Felix Roland, of Paris, has constructed a machine which satisfactorily answers the much-desired end of separating the fiber from the bark and the bark from the stalk; and that this machine has been purchased by the French Government, with the intention of sending it to the French settlements in Guiana, Cochin China, Reunion, and Guadeloupe. And, further, it is stated that all

these colonies have, in consequence of the inducements offered by this machine, taken up the culture of ramie.

The American aloe, as it is commonly called (*Agave Americana*), furnishes from its leaves a fiber of various qualities, from the finest to the coarsest, and has to some extent—but never, that we are aware of, in this country—been utilized for textile purposes, such as the making of paper and ropes. It grows naturally in a wide range of climate, and is common in Western Texas, Mexico, some of the South American States, and in India. In Bengal its fiber is more used, probably, than elsewhere. The consul of the United States at St. Helena, where, it seems, the aloe grows readily in large quantities, has written to the Department for information concerning the mode of cleaning and preparing the leaf for market. The leaf of the St. Helena plant, he remarks, is much thinner than that of many other localities, not being much over a quarter of an inch in thickness.

The consul inquires particularly, in behalf of persons residing at St. Helena who contemplate the utilization of the aloe, whether there is any machine of American manufacture for crushing, cleaning, and preparing the fiber for market. We have replied that there is not, within the knowledge of the Department, any such machine as he describes, and that the kind of machine best suited to the purpose is such, probably, as is used in the manufacture of flax and hemp, of which there is a great diversity, those that apply the crushing power of fluted rollers being regarded as most successful.

The process of preparation in Bengal—where the aloe is utilized for the manufacture of its fiber, but not to very great extent, and never for trade—is as follows:

> The leaves are cut and thrown into water for three or more days, after which they are taken out, macerated, and scraped with a rather blunt instrument. It was found that the leaf-fibers were loth to rot, owing to a milky, viscid juice which they contained. This defect, however, has been considerably obviated by very hard crushing, or pressure, between heavy cylinders, which, by expelling the moisture, renders the fiber more pliable for weaving and other purposes.

The fiber of the American aloe is known in commerce as "pita," a term generally given in Spanish America to fiber-bearing plants. A correspondent in New York advises the Department that he proposes to introduce the pita to the commerce of the world during the present year, having under his control a very large extent of country—some 400,000 acres—covered with the growth of the wild aloe. He estimates that it will cost from $75 to $80 a ton to place the fiber upon our markets, and states that he has been offered $200 a ton here, and that from Aberdeen and Dundee, in Scotland, and Dublin and Belfast, in Ireland, he has similar offers. There is an increasing demand for fibrous material, chiefly for paper-making.

Our correspondence on this subject has not been confined to the plants above mentioned. We have had several requests for information respecting New Zealand flax (*Phormium tenax*), more particularly from Oregon, where it is proposed to introduce the culture upon a somewhat extended scale. The adaptability of the plant to that region must be decided by experiment. It is said that it will endure twenty degrees of frost without injury. We have been able to furnish a quantity of small plants for the purpose of trial.

The inquiries which have been addressed to the Department in reference to the New Zealand flax have mainly been directed to the question whether any practicable method has been discovered of separating the

gum from the fiber. To these inquiries the Department has answered that if any definite mode of preparing the fiber exists it has not been made public. Various recorded attempts could be cited, but the best has been only partially successful. The gum can only be separated under water.

The comparative value of this plant is a matter to be considered by those who contemplate its cultivation as a commercial fiber. The fiber may undoubtedly be utilized with advantage for certain purposes—the manufacture of paper, for instance. It forms a strong rope; but, as it is easily broken by any flexure, it is not suited to the manufacture of canvas. For cables and ropes under water it may be valuable, but there is no steady demand for it.

In a letter to the Department from the United States consul at Singapore, in which the writer speaks of a recent excursion into the interior of the peninsula of Malacca—in a great measure a *terra incognita*—allusion is made to the wonderful vegetation existing there generally, and to many useful things unknown to civilized commerce, among which is mentioned a remarkable fibrous vine, of unusual strength, used by the natives, instead of rope, to fasten their boats, and for many other purposes, and as a fiber worked into fishing lines, nets, &c. Our correspondent thus describes this newly-discovered fiber, which he regards as promising to be of great value:

I found the vine growing in the low river-bottoms of Malacca in great abundance, and from all accounts it is to be met with, wherever there is a jungle, throughout the southern half of the Malay Peninsula. It creeps upon the trees and branches, and hangs down to the ground like small rope. It is of very rapid growth, so that on becoming an article of merchandise the supply, in large quantities, could be kept up constantly. The fiber is found next to the wood, covered by the outer skin, and while in its green state can be easily removed and drawn off (if done with a little care) in good length and almost entirely free from skin-attachment. The Malays told me they considered it the strongest known fiber, even stronger than silk. They twist it by hand into thread and small cords for fishing lines, nets, snares, and other purposes. Spinning and weaving, especially the former, being very little practiced in the Malayan states, I have thus far been unable to see any tissue or fabric made of this fiber, but I feel certain that it can be spun and woven; and, probably, owing to its wonderful strength, fineness, and smoothness, into the finest imaginable tissue, as fine as the pina-cloth of the Philippine Islands. Twisted into a twine of about $\frac{1}{25}$th of an inch in thickness, I have shown it to shipmasters, some of them very strong men, and they have not been able to tear it apart with their fingers, and have pronounced it, for strength and smoothness, superior to any cord of known material.

We regret that a sample of this fiber forwarded by our correspondent has failed to reach us.

SUGAR IN THE SANDWICH ISLANDS.

In response to a request of the Department for information concerning the cultivation and manufacture of sugar in the Sandwich Islands, we have received from James Scott, esq., the United States consul at Honolulu, the following detailed sketch:

You ask that I give you some idea of the culture of sugar in the Sandwich Islands, embracing the different varieties of cane employed, the peculiar properties of each, and their relative nature, as well for making sugar and sirup as for their endurance and capacity for resisting injuries by the cold.

There has been little done on these islands as yet in the way of gathering and putting in form statistical information on the subject of sugar-culture, and I must rely on such information as I can obtain from other sources.

Sugar-cane is indigenous to the Hawaiian Islands as it is to all the principal islands in the Pacific, and it was noted by Cook in his visits to these islands as being "of large size and of good quality." The natives, however, made no use of it beyond that of food, and it was not until foreigners settled on the islands that any attempt was made

to utilize the vast fields of wild cane that natives say grew in every valley and plain of the islands.

Sugar-cane was first utilized and made into sugar and sirup about 1819 in a primitive kind of way. Sugar and molasses began to be manufactured for exportation in 1837. That year there were exported 4,286 pounds of sugar and 2,700 gallons of molasses. In 1876 there were exported 26,072,429 pounds of sugar and 139,073 gallons of molasses.

The process of manufacturing sugar and molasses on these islands now is the same as in other countries. The machinery has all the most recent improvements. The power used to propel the machinery is water and steam. The sugars made now are almost all of refinery grades, and with little exception exported to the United States.

The varieties of cane used are as follows:

1st. White cane, common to the soil, somewhat resembling the Tahiti variety, being, when under a good state of cultivation, of a pale greenish-yellow color, deepening on the latter shades as it matures; rather soft rind, long pointed, with the eye or bud partly sunken in the stalk; tassels freely and ratoons well in most localities.

2d. The white cane, inclined to a straw color when ripe, an inferior cane lacking richness of juice, and but little cultivated.

3d. The ribbon or striped cane, green and purple, rich and juicy, and preferred in high-land cultivation.

4th. Purple canes, rind and joints hard, requiring great power in crushing.

5th. "Tahiti" or "Ko Pake" cane, of the yellow variety, rich in juice, prolific, trashes easy, and with good cultivation ratoons well.

6th. Pua-ole or arrowless cane, a favorite cane in many localities, as it can be allowed to stand over without much detriment, if any, and does not exhaust the soil.

The first and last two varieties of cane are almost entirely used and severally preferred as they may suit the soil and altitude in which they are planted.

The fifth variety is said to be much the best for lower lands. There is a difference of opinion here as to its origin. Some say the seed came from Tahiti. They call it Tahitian cane; and others say the seed came from China, and they call it by the Hawaiian name "Ko Pake," or Chinese cane. The Tahitian cane, or "Ko Pake," is certainly a very fine cane. It grows tall and large, and has more saccharine matter and less woody fiber in it than any other cane known in the islands. On 19 acres, measured on the island of Maui, there was produced from this seed last year 99 tons of sugar, or 5¼ tons to the acre.

The sugars and sirups produced here are of an excellent quality. As we have no frosts or cold weather on these islands so low down as the sugar-growing plane, it is impossible to say what capacity the cane has for resisting injuries from cold. The mercury ranges here the year round between 69° and 89° Fah. Rarely does it go above or below these figures.

I am informed by some of the sugar-planters here that seed-cane of these islands could be transported if it is thought desirable to test its qualities in the United States

EUCALYPTUS, CINCHONA, AND COFFEE IN GUATEMALA.

Our correspondent in Coban, Guatemala, to whose letter on the subject of ramie we have referred above, states that the eight species of eucalyptus, the seeds of which he received from the Department, are growing beautifully, and that a beginning is likewise being made, with promise of success, with the cinchona. Coban is 4,300 feet above the level of the sea, and is generally denominated the "Alta Vera Paz," being the capital of the department of Vera Paz, on the Rio Dulce. The temperature is remarkably equable, being seldom less than sixty nor more than eighty degrees; and the fertility of the soil is increased by an abundant rain-fall, adapting it to the culture of almost any plant, with the exception of such as may require winter rest. Our correspondent says:

We have in the Alta Vera Paz a number of United States agriculturists, and our little American colony is increasing rapidly. They are planting coffee, for which culture this part of Guatemala is more advantageous than any part of Mexico or Central America which I have seen.

AUSTRALIA.

From our correspondence with the different colonies of Australia we have received much valuable information respecting the agricultural

condition of that progressive country, as well as important additions to our stock of exotic and economic plants. The directors of the botanic gardens at Melbourne, Adelaide, Brisbane, and Hobart Town have responded liberally to our requests for information and to our system of international exchanges of agricultural publications and seeds.

From Brisbane, the Department has been favored with a small supply of sugar-canes, of the different varieties which are cultivated in Queensland, with a view of testing the practicability of the safe transportation of the canes for the purpose of introducing them into the sugar districts of our Southern country. These samples have been distributed to reliable cultivators in California, who were disposed to make a trial of them on the Pacific Coast. It is hoped that the experiment of introducing these foreign canes may be extended to Louisiana and Florida, and elsewhere within the Atlantic sugar-belt. The canes comprising the present experiment, as our correspondent at Brisbane informs us, were originally obtained from Mauritius, Java, New Caledonia, and the South Sea Islands, and are some of those which are found most suitable for cultivation in Queensland, where they have succeeded well as far south as lat. 28°; and they have also been cultivated in New South Wales, several degrees farther south. Such of these varieties as may be best adapted to cultivation in our Southern States can only be ascertained by experience, as the same plant is so modified, both in habit and appearance, by change of climate and soil, that in some instances it presents the appearance of a distinct variety.

AGRICULTURAL COLLEGE IN JAPAN.

The Department has been favored with a dispatch from the Minister of the United States in Japan, embracing an account of the inauguration of an agricultural college in the city of Tokei.

The occasion appears to have attracted great attention among the Japanese, and is not without interest to agriculturists and friends of progress throughout the world. The entrance to the college was decorated with flowers and with the national flag. Okubo, minister of the home department; Kawaji, chief; and Ando, inspector of police, with their secretaries, were there, dressed in uniform. The Mikado attended, having in his suite His Imperial Highness Arisugawano-Miya and several other princes of the blood, their excellencies Sanjo, Iwakura, Oki, Okuma, and Ito. On his arrival at the college His Majesty was saluted by the band of music of the navy. The minister of the home department and the master of the ceremonies preceded His Majesty to the place of the ceremony; there the home minister presented the rules of the college to the Emperor, who spoke as follows in reply:

> We, the Mikado, consider agriculture the foundation of a country; through it the earth is made to offer its fruits and the people prosper; and therefore that science is of the greatest importance. We have been well pleased with the report that has been submitted to us concerning the objects of this college, and we have come in person to open it to the public. It is our earnest hope that this school will contribute to increase the produce of our soil and the prosperity of our subjects.

Okubo, minister of the home department, then delivered the following address:

> Your Majesty, the Emperor, on receiving the report of the completion of the buildings of the agricultural college, graciously resolved personally to perform the opening ceremony. Your Majesty has in your wisdom, declared the science of agriculture to be a most important one, and it is a fortunate thing both for the country and the people that Your Majesty, by establishing this school, where agriculture will be treated as a science, increases the fertility of the soil and the prosperity of the people. Your

Majesty's servant, Toshimichi, will bear in mind your wise intentions, and devote himself with zeal and diligence to this task. From this day the agriculture of our country will gradually improve, the soil become more productive, the people more wealthy. I, Okubo Toshimichi, minister of the home department, and Your Majesty's servant, most respectfully offer my congratulations on this 24th January, the 11th year of Meiji.

Dr. J. A. McBride, in the name of the foreign teachers, then said:

Your Majesty, the Emperor, has graced the opening ceremony with your presence, and your foreign servants, J. A. McBride and his colleagues, feel greatly honored by this act. Your foreign servants, having been appointed teachers of agriculture, bear a heavy responsibility, and thanking Your Majesty for the favor conferred, we shall briefly state what we consider to be our duty. In our opinion the wealth of a country has its root and foundation in agriculture. Your Majesty has always taken great interest in agriculture, and we, your foreign servants, feel the responsibility we are under to teach the pupils of the college the science of agriculture in all its branches. At present the best methods of choosing seeds, sowing, feeding cattle, using manure, &c., have been closely investigated in Europe, and tools and machines for agricultural purposes have been improved and multiplied. We, your foreign servants, will attend to these matters, and by giving both theoretical and practical lessons in farming we hope to hasten the progress of agriculture in Your Majesty's dominions.

His Majesty's reply was as follows:

The buildings of the agricultural college being completed, we, the Mikado, now declare the college opened. We hope that you will co-operate with our intention to improve agriculture by teaching your pupils, and thus advance farming in our country.

AGRICULTURAL INSTITUTIONS OF SWEDEN AND NORWAY.

The Department is indebted, through the Secretary of State, to the Hon. C. C. Andrews, late Minister of the United States at Stockholm, for the interesting information embodied in the statements below, in relation to the various agricultural institutions of Sweden and Norway, embracing their organization, equipment, economical management, course of instruction, the appropriations by which they are sustained, their careful supervision by the government, &c. The facts in these various particulars will not only be interesting but instructive to our farmers, as showing the liberal public support which is awarded to these institutions, and the scrutiny exercised by the government in the direction of their affairs.

There are in Sweden an Academy of Agriculture, two agricultural colleges, twenty-seven agricultural schools, and twenty-six county agricultural societies. The Royal Academy of Agriculture was founded in 1811, and is located at Stockholm. The King, who habitually attends its annual meetings, is its patron, and the crown prince is its first honorary member. The object of the academy is to acquire from experience and science and to diffuse knowledge of experiments and inventions useful for agriculture, and by that means, as well as by the distribution of rewards, to effect improvement in agriculture and kindred industries. It maintains correspondence with the county agricultural societies for the reciprocal interchange of information; publishes an agricultural periodical; supervises an experimental farm, situated two miles from Stockholm, and which is provided with a residence-building, a laboratory, mills, and all the means for scientific farming; and directs the operations of a corps of twelve agricultural engineers, who are paid by the state, and who travel through the country to implant information in respect to drainage, architecture, and other matters pertaining to the practice of agriculture. It has a director—the present incumbent being an ex-minister of the crown—who is its presiding officer; a secretary, who keeps the records and library, assists the director in the general administration of the academy, keeps informed on agricultural literature, and edits the writings published by the acad-

emy; and a cashier, who attends to the collection and disbursement of the funds of the academy, and renders accounts, with estimates of receipts and expenditures.

Membership is limited to twenty-four honorary members, who are appointed by the royal government on the proposal of the academy, one hundred and thirty-six working, and seventy-five foreign members, chosen by the academy from men known for knowledge in general, and experience and insight in one or more of the matters within the scope of the academy's operations. Of the working members at least thirty-six are to be residents of Stockholm or its neighborhood, and are to serve on the six following committees, namely: ten members on the committee on agriculture, which committee concerns itself with field culture and stock-raising; six on a committee on forests, horticulture, and gardening; four on a committee on agricultural machinery and implements; four on a committee of agricultural science; and four on a committee on statistics.

The director and secretary are by virtue of office members of each committee. The academy selects one member of each committee to act as chairman and reporter. The director, the six chairmen, the secretary, and the cashier compose a committee of administration. The academy ledger is to be finished and delivered to the committee of administration at the end of April of each year, which committee reports the result of the examination to the academy. The latter, if it chooses, can appoint another committee to examine the ledger again. The academy awards prizes for agricultural improvements and essays to foreign as well as to home competitors.

The gentry and wealthy landed proprietors in Sweden usually carry on their estates themselves (through an inspector), living upon them in the summer and occasionally visiting them in the winter, instead of renting them out. Though they do not themselves perform manual labor in the fields, they are, however, thoroughly acquainted with the details of agriculture. Many of the most successful of these persons are members of the Academy of Agriculture. So also several officials living at the capital, and persons distinguished in statistics, chemistry, and other branches of science, are active members of the academy. It may well be supposed, therefore, that the discussions at the monthly meetings (except in July and August) of the academy, and of which abridged reports are published in the press, are of much interest and benefit to the public. The annual reports of its different committees are also valuable contributions to agricultural literature.

The Academy of Agriculture has a permanent fund, originally granted by the state, but increased from time to time by private donations and bequests, of about half a million of crowns, the income from which is, say, $6,500 a year. The appropriations of the state for the present year, a part or all of which are disbursed by the academy, are as follows: pay of the corps of agricultural engineers and assistants, 45,350 crowns ($12,000); for the general promotion of agriculture and rural industry, 166,950 crowns ($44,000); for drainage, 80,000 crowns ($21,333); for improving the breed of horses, 94,244 crowns ($25,000); in all, say, $102,000 in gold.

Agricultural Colleges.—As stated above, there are two of these; that of *Ulturna*, near Upsala (north of Stockholm), which was opened in 1848, and that of *Alnarp*, in the south of Sweden, which was opened in 1861. They have a similar organization, and are well provided with natural collections, anatomical models and diagrams, a laboratory, machinery, and all such objects as are essential to such institutions. Connected with each college is a good farm and dairy.

The amended law of May 8, 1868, on the organization and management of the Ulturna College (called "Ulturna Landtbruks Institul") provides substantially as follows: The object of the institution is stated to be not less to impart to its pupils the theoretical and practical knowledge required for a proper management of agriculture than to present an example of systematic agricultural economy in all its branches. To accomplish this aim, the institution, so far as its resources will permit, must keep pace with the development and progress of agriculture in all its branches, both at home and abroad. The board of administration consists of a president and four members, selected by the government from among men instructed in agriculture, and zealous for its advancement, together with the director of the college. The term of service of some one member, to be determined by lot, not including, however, the director, shall expire annually. It is the duty of the administration with caution and zeal to seek to promote the aim of the college; to appoint capable instructors, a necessary number of employés, and to fix their pay; to decide upon the application of pupils to the college, and to fix their tuition; to dismiss teachers, pupils, and employés when necessary; to recommend to the government, when deemed necessary, the dismissal of the director; to apportion among the instructors the matter to be taught; to issue in more detail the rules which are required for organizing a teachers' committee, which has to express itself on questions concerning instruction at the college, and order and discipline among the pupils and apprentices, and for a plan of economical management of the property of the college; to be responsible for the keeping at hand and application of the appropriations for the college and its other income; to send yearly to the chief of its civil department (minister of the interior) a report of the operations of the college; and constantly to watch over the exact execution of all the regulations prescribed by law for its government. The board of administration is to meet every three months at the college, and oftener if necessary; it appoints some one to keep a short record of its proceedings, and a member in the minority may have his opinion recorded therein. Four members constitute a quorum. Neither the president nor any member of the board, except the director of the college, receives compensation for his services.

The manager ("Foerestaondare") under the title of director, with the dignity of professor, should possess the qualities needful for a chief insight into all the subjects taught at the college and complete knowledge of the science and economy of agriculture, and well-proved ability in its practice. It is his duty to keep informed as to the progress of the theoretical as well as practical instruction, of the mutual relations of the teachers and pupils, of the management of field culture, the dairy and stock and other branches of economy, and according to the nature of the case either correct what is lacking himself or submit it to the administration, and thus see to it that good order and system are exercised without restraining the individual activity of the teachers and employés; to guide as well the theoretical as the practical instruction at the college, and besides perform the teacher's calling which the administration assign him if they think he has time for such duty; to see that the scientific and other collections are completed and kept in good condition, and to such end cause exact inventories to be made and kept for reference; and also, according to a plan approved by the administration, to devise and carry out experiments; to submit to the administration a plan of management of the real property of the college; to be chairman of the aforementioned teachers' committee, and after the committee has been heard, furnish a plan of instruction and proposal of regulations for

the college; to report to the administration the operations of the college between the meetings, and also submit to it estimates for the annual report; to conduct the legal actions of the college in judicial and communal matters, and guard its rights and welfare; to be responsible to the administration for the advantageous management and care of the property; to scrutinize claims and thereon make orders for payment; also to examine and approve before it is delivered to the administration the final annual account of receipts and expenditures; to accept and dismiss servants and other dependants, and over them exercise housekeeper control; to see that proper sanitary regards are taken; to grant teachers and employés, and pupils, leave of absence not exceeding eight days; to be absent himself from the college not over four days at a time without the consent of the president of the administration; to report at the meetings of the administration all the business which he is unable himself to undertake; to carry into execution the resolutions of the administration; and if obstacles intervene to notify the president thereof; to deliver the cashier's estimate of receipts and expenses for the ensuing year, the same having been previously tested at the administration's ordinary meeting; in prescribed order and in turn with the instructors and employés, take part in the eating with the pupils.

Under the superintendence of the director are the three following employés: (1st) an inspector who is to instruct in mechanical agriculture; personally guide and superintend the agricultural work in all its branches; have care of the building, live-stock, and stores committed to his trust; to exercise direct supervision over the pupils when they are occupied with agricultural labor, and over the apprentices and servants, regarding their behavior; and see that they fulfill their duties; to make yearly, under control of the director, and in presence of the cashier, an inventory of the stores of products, stock, machinery, and other movable property, and deliver the same to the director; to keep a journal of the work on the estate and a list of the products therefrom in grain, fodder, &c.; to examine and correct the accounts for outlays on the estate, and deliver the same for the director's approval, and in case of the director's sickness or absence, assume his duties so far as they concern economical matters; (2d) a cashier ("Kamaeraven"), who is to keep and to be responsible for the accounts of the resources of the college, its yearly income and expenditures, as well as of the means and surplus intrusted to him; to make all payments for the college after they have been approved by the director; to give instruction to the pupils in bookkeeping, if the administration so requires; to deliver to the president of the administration, also to the director, before the 5th of every month, a cash report of the receipts, disbursements, and deposits of the previous month, wherewith an inventory of funds on hand shall be made, and which, with the vouchers, shall be examined and indorsed by the directory; (3d) a bookkeeper, if such an assistant of the cashier is deemed requisite.

The employés cannot absent themselves from the institution without the director's consent, nor quit their situations—at their own instance—sooner than three months after they have given written notice thereof to the administration. The chief of the civil department appoints for a term of two years, as revisers, three men skilled in agriculture and accounting, who shall meet at the college on the second Wednesday of every June, and with exactitude examine into the general administration of the college, yet preferably into its economical and pecuniary relations; they shall have access to the record or protocol of the board of administration, and their other transactions. The director shall be heard in respect to every matter of criticism. If the criticism is determined

upon, it shall be given in writing to the board of administration, which latter within a month shall give its declaration thereon; thereafter it depends on the revisers whether the criticism remains or is dropped. Their report is delivered to the board of administration, which without delay sends it, with accompanying documents, to the chief of the civil department. The revisers are paid their traveling expenses.

As the foregoing relates principally to the *economical* management of the institution, it has been thought proper to give an almost literal translation of the law. What follows in respect to the course of instruction, &c., may perhaps be given with more brevity. Instruction at the college embraces a higher and lower course, in each of which agriculture itself and stock-raising are to receive the principal attention. All of the instruction is to be decidedly practical. The higher course embraces the scientific principles of agriculture, such as physics, chemistry, mineralogy, botany, zoology, anatomy, physiology; also, practical knowledge of agriculture, stock and dairy management, agricultural economy, including its administration, the support and application of labor, plan of management, rotation of crops, &c.; bookkeeping, garden and forest management, practical geometry, mechanics, drawing, rural architecture, and industries kindred with agriculture. The lower course embraces penmanship, composition, and writing from dictation, arithmetic, including the rule of three and decimals, and a full knowledge of the Swedish money, measures, and weights, drawing of simple machinery, practical arithmetic, and application thereof as to superficial and solid contents of figures, map-making, the general principles of agriculture, varieties of soil and manure, the proper rotation of crops, &c., stock-raising, gardening, smith and mechanical work, working by agreement, accounting.

During the course, which lasts two years, the pupils are expected, in the regular work of the college farm, to acquire readiness in plowing, laying out of fields in different crops, and in the general practice of agriculture, the making of open and under drains, stacking of grain, hay, and straw, sowing by hand, &c. The pupils are therefore to serve by turn in the stable and farm yard, and, in the degree they show themselves capable, to supervise work, apportion it, and keep tally of its execution. Theoretical instruction in the higher course may be suspended for not exceeding eight weeks in a year. The ordinary teachers shall unconditionally reside at the college. Extraordinary teachers are employed when occasion requires. The pupils are divided into two classes—those in the higher and those in the lower course. At least twenty-four paying and four free pupils are received, and twenty-four free apprentices.

The pupils must be eighteen years of age or upward, and have passed the examination for admission to the university, or otherwise present certificates of qualification. Pupils of the same class have the same sort of subsistence, which is to be "healthy and sufficient." Each has a separate room, so far as may be, and a separate bed. No teacher or employé is allowed to furnish the subsistence. The apprentices occupy rooms together, but with separate beds. They are bound to remain two years at the college, and stand in law to the director in the relation of servants. Before admission they must have performed their military duty, practiced agriculture at least a year, be able to read readily, write a readable hand, know the four principal rules of arithmetic, and be of respectable character and sound health. Should an apprentice distinguish himself for industry, and inclination, and uncommonly great advancement in knowledge, he may be transferred to the class of pupils, and preferably to other applicants for admission to the college.

The graduating examination of the pupils is partly oral and partly in

writing. Public notice of it is to be given in the official newspaper, and announcement of the same made to the chief of the civil department and the administration committee of the Academy of Agriculture. The administration of the college are also to be present and take part in the examination. There are now seven instructors at this institution, besides the director, inspector, and cashier.

The president of the board of administration is Count Hamilton, governor of the county of Upsala, and one of the members is an ex-minister of the crown.

No separate appropriation is made for this college. The whole appropriation for instruction in agriculture and rural industry is made in one sum of 170,400 crowns ($45,440). This college receives of this amount 27,500 crowns ($7,066). Its receipts from pupils amount to 29,000 crowns per year; and the gross products from its farm are 12,000 cubic feet of grain, 14,000 cubic feet of root crops. and 10,000 hundredweight of hay. The annual expenses of the institution, including the dairy, school, and experimental station, are 67,000 crowns.

The organization and support of the agricultural college at Alnarp are about the same as above stated for Ulturna. Its real and personal property are valued at 462,498 crowns. It received during the year from the state 29,400 crowns, and from the county agricultural society 3,000 crowns; from pupils, 27,677 crowns. The earnings of its apprentices were valued at 9,253 crowns. The expenses of the institution for the year were 250,809 crowns ($66,600), and its net receipts were 2,405 crowns.

Agricultural schools.—The first of these schools was established through the efforts of Mr. Edward Normen in 1835. The revised regulations for their organization, issued by the civil department the 13th of April last, set forth that their object is to impart to young men inclined to follow the profession of agriculture the knowledge, practice, and efficiency therein which are necessary for its proper exercise, and that they are to be so conducted that each school, and the farming and care of stock therewith connected, shall serve as a practical example, having due regard to locality, of good and carefully managed agriculture.

The board of administration of each school is chosen by the county agricultural society of the county in which it is situated. Report of such choice and of any change must be made to the Academy of Agriculture and to the government of the county. Each school has a director, who is known as a skillful agriculturist, a principal teacher and assistant teacher, and an instructor in smith and mechanic trades.

The course of study lasts two years. At least twelve free apprentices are taken at each school, who severally must have reached the age of eighteen years and have had a year's previous practice in agriculture. They stand in the relation of servants to the director, and are to be furnished with healthy lodgings and subsistence. The pupils and apprentices have practice in agriculture on the farm upon which the school is situated. The instruction is similar to that of the lower course of the agricultural colleges. The director prepares a plan of instruction every autumn, which must be submitted to the board of administration and the Academy of Agriculture. He reports every March the operations of the school to the Academy of Agriculture, which report is to be certified by one of the school board of administration. He is to watch over the school's equal progress, and see that good order and morality prevail therein.

County agricultural societies.—There are twenty-six of these, and they are known here by the name of "Hushällnings sällskapen." Their or-

ganization consists of a president, who is usually the governor of the county, a vice-president, and a secretary. These societies severally hold every summer a meeting and exhibition, at which premiums are awarded and discussions held. Each society has an office, open the year round, and is the organ of communication between the farmer and the central bureau of statistics, distributing for the latter blanks and furnishing it with returns of the crops, farm wages, &c., as they are considered here, and as they undoubtedly are, very useful; and their membership comprises the solid men of the country. Their support is derived from one-fifth of the tax on the retail of spirits.

The tax collected in Sweden in 1874 on the production of spirits was $3,718,535 in gold. There is also a tax collected on the retail of spirits in less quantity than fifteen cans, and which for the year 1874–'75 amounted to 3,662,504 crowns, or nearly one million of our dollars. The proportion of this which went to the county agricultural societies was 544,484 crowns, or $148,000. It may be remarked that the expense of preparing and publishing the regular annual agricultural report is not paid out of the agricultural appropriations, but out of the appropriations for the central bureau of statistics. No separate appropriation is made for that report, nor for printing agricultural blanks.

It will be seen from the foregoing that the appropriations for (or which are disbursed by) the Academy of Agriculture, for agricultural instruction, and for the county agricultural societies, amount to $295,440. Under the head of appropriations indirectly in aid of agriculture may be mentioned the following: Owing to a practice which obtained in certain countries in old times, of the actual partition of lands among inhabitants of villages, many farms came to comprise a large number of detached parcels lying in all possible directions and scattered over an extent of several miles—a state of things greatly prejudicial to agriculture. For a number of years, therefore, the state has been carrying on a system of survey and equitable distribution of these private lands, though now principally at the cost of the party concerned, so that each farmer shall, as far as practicable, have his property in contiguous tracts. This is called the system of change (Skiftets vasendet). On the other hand, the state assumes more of the expense of the so-called system of distribution (Afrittring vasendet), it being the equitable partition and allotment of lands in the timber regions, which heretofore have been held in common by the state and by private individuals, and where the ownership was much mixed.

The appropriation for this year, for both these systems, was $72,700, and for help in moving after the survey $29,000. The appropriation for the administration of forests, under the department of finance, including instruction at the forest institute and forest schools, was $204,597; for veterinary practice and instruction, $70,000; in all, appropriations indirectly in aid of agriculture, $376,297; which added to the $295,440 appropriated directly in aid of agriculture, gives the sum of $651,737 as the appropriations by the Swedish Rigsdag for direct and indirect aid and for the protection of agriculture.

The amount and object of any other current appropriations, tending to advance the progress of industrial science and improvement of the arts of rural industry, may be seen from the following appropriations by the Swedish Rigsdag: Industrial art schools at Stockholm and Gothenburg, $17,376; for the general promotion of industrial arts, $20,000; for technical instruction, $70,920; in all, $108,296.

The system of taxation of land in Sweden is extremely intricate, and its reform constitutes one of the leading political questions of the day.

It will be impossible to state with precision what the rate of *taxation* is, because it varies so much for local purposes in different communes. In financial respects, landed property in Sweden is divided into as many as three different classes. One class, known as the *säterier*, and which till 1810 could only be held by the nobility, is entirely exempt from tax, the privilege having been granted several centuries ago on condition of the owner rendering military service. The service, of course, long since ceased. This class comprises about a seventh part of the private lands. Another class, known as the *frälse*, is, to a considerable extent, exempt from tax, and is estimated to comprise a third part of all the private lands. Upon the remaining and principal part of landed property there is the ordinary State tax, which is 3 öre (eight mills) on every hundred crowns ($26.80) of assessed value, and the commune or parish tax, for support of common schools, the church, the poor, and for some other local charges, and which varies according to the condition and needs of the commune. The main support of that part of the army called the *Indelta* also falls upon this land, in pursuance of an understanding entered into about two centuries ago, whereby every district or "rote" should *actually* furnish a soldier.

Another burden is the keeping in repair the highways. The whole of the public charges upon such land, in money and in kind, according to the best information I have been able to obtain on the point, is four per cent. of its assessed value. The assessed value, however, is usually less than the actual value. Were it not so, the tax would in very many cases equal the income from the land. The proprietor finds further alleviation from the burden through the system of cheap farm labor which obtains, that of paying for labor by leasing a *torp* (a cottage with a small field and pastures for a couple of cows), of which there are four or five distributed over every large estate.

Assessment and levying of taxes.—As aid in obtaining a proper valuation of land, it is made the duty of judges of district courts to report to the county governor, for delivery to the "tax preparers," a statement as to each parish of the purchase value of lands as set forth in the latest deeds. Mortgage corporations must report the value of land as set forth in mortgages; and insurance companies must report the value of buildings thereon as set forth in policies.

"As tax preparers," the governor of the county appoints from among the residents of a district one to be chairman and reporter, and two assistants. Notice of their selection is to be published before the end of January in each year; and their work must be commenced in season to be finished before the end of May. During the month of March the clerk of the court must deliver to the chairman lists of property to be taxed and a sufficient supply of blanks. The board fill up the blanks and their estimate of the value of the land and of the amount of tax thereon, which must be delivered to the chairman by the middle of April, and by him delivered to the presiding officer of the communal meeting. Notice is then published as to where the list may be seen for examination by the public. Tax payers who are dissatisfied with the estimate can submit to the tax committee the reasons for any charge therein. In the country, every pastorate, as a general rule, comprises a tax district for which the county governor orders the election of a tax committee, which election is held within fourteen days after notice has been published in the parish. In the country the committee is composed of nine members. If, however, the district comprises more than one pastorate or church society, it may consist of ten members, five to be selected from each society. An elector may vote by proxy if he or she so desire, for in such elections

single women or widows who own property can also vote. At least six members of a committee are necessary to constitute a quorum. The governor of the county may take part in the proceedings of the committee, but not in their decision. He acts as chairman if present; but if not present, a chairman is chosen by the committee. A public attorney is to be present at the deliberations of the committee to guard the public interests, and to give the necessary information. The county attorney is responsible for keeping the record of the proceedings. If the tax committee are divided as to a valuation or tax, the voting is to be open. The meetings are with closed doors, but persons interested are admitted. No member is to act when his own interest is in question. Within fourteen days after the committee have finished their proceedings, the record of any alteration of the preparing boards' estimate, duly certified, must be delivered to the president of the communal meeting. Due publication of the same is to be made and is to be held for examination by parties concerned. Within three weeks after the tax committee's work is finished the record of their proceedings is to be forwarded by the clerk of court to the county governor. Before the tax committee adjourn they are to select four persons to be eligible as members of the board of tax examiners, to try and determine the taxation, objections, and remarks made by the tax committee.

This board of examiners, really an equalization board, consists of as many as twenty but not exceeding thirty, who are selected by the county governor, out of those proposed by the different tax committees. It meets at the county seat in September. Due notice is published of the membership of this board, and of the time and place of meeting. Those who object to their tax must deliver their complaint in writing to the county governor previous to the meeting of the board. The county governor is chairman. If there is occasion for voting the vote is to be open. The treasurer of the county is to be present to watch the public interest. The journal of the proceedings is kept by a person designated by the county governor. Before the end of November extracts from the journal, showing any alterations or additions by the examiners, shall be communicated to the president of the communal meeting, in the proper commune. Notice of the same shall be given, and such record shall be accessible to parties concerned. As well the public attorney as the party taxed may prefer objections against the proceedings of the examiners, which are directed and forwarded to the chamber court (Kammar Rätten), the fourth authority which acts upon the matter. The latter gives its decision before the end of March of the next year, but such objections and complaint or appeal is not to delay the payment of the tax, which, however, is to be returned if found to have been illegal.

Members of the different tax boards enjoy the protection and security granted by the constitution to members of the Rigsdag. After the different tax boards have finished their duties, the amount of taxes is to be promptly entered in the tax books. At least fourteen days before the collection of the taxes notice of the time and place thereof is to be published by the county governor. The clerk of the district court attends with the collector during the collection. The collectors hold their offices during good behavior. There are from three to eight in a county, according to its size.

In the department of the interior of Norway an officer is employed as "Konsulent" (adviser or director) on the subject of agriculture. He is the organ of the government in its correspondence with the different public agricultural institutions. This officer is also one of the six directors of the most important of the agricultural associations of Norway,

namely, that one which is called the *Royal Society for the Promotion of the Welfare of Norway.* This society was founded in 1809. Its capital fund amounts to 201,835 crowns, and the annual appropriation for it by the state is 16,000 crown. His Majesty is the patron of the society, and Mr. Stang, the prime minister, is its first director. This gentleman presided at the recent meeting of the society, which was also attended by quite a number of prominent agriculturists from various parts of the country, and takes an active interest in its affairs.

There is a public agricultural high school or college at Aas, a short distance south of Christiania, which has one director and five teachers; also a board of three inspectors. There is a farm connected with the institution. There are also five county agricultural schools, each of which has a director.

The appropriations this year for the promotion of agriculture, including the instruction and improving the breed of stock, was 178,800 crowns. Including the item just above mentioned the appropriations directly for the advancement of agriculture are 194,800 crowns, or $52,000.

It is the rule in Norway that where public money is granted to local agricultural or industrial institutions, the communes where they are situated must contribute an equal amount.

The appropriations for four technical schools and for industrial instruction amount to 50,000 crowns ($13,333). Under the head of appropriations indirectly in aid of agriculture, might be included that for the administration of forests, 190,400 crowns, and that for the allotment of wood-lands (the separating of public from private lands) 136,600 crowns. Considerable appropriations are made each year, both in Sweden and Norway, for geological surveys and maps; but it has not been thought desirable to include these, though they surely have much influence on agriculture. The same might be said as to appropriations for roads and canals.

There is no state tax upon lands in Norway; they are, however, subject to a communal tax for school, pauper, and church expenses. This tax, of course, varies according to the requirements of different communes. It is believed to amount on an average to from fifteen öre to twenty-five öre per 100 crowns value, or about a quarter of one per cent. The present valuation of lands is the same as fixed by commissioners during 1820–1830. A new valuation is now in progress. Proprietors of land in Norway must keep the highways in repair; but they are not required, as in Sweden, to furnish soldiers. However, the agricultural population, in common with other classes, have to give some of their time for military exercises.

TURKISH RHUBARB.

Frequent inquiries from correspondents, who were desirous of introducing the cultivation of what is commonly known as the Turkish rhubarb (*Rheum officinale*) have led the department to take measures for the importation of a supply of the pure seed from Tartary, where it is grown, and from whence it is exported to Europe, through Turkish ports, from which fact alone it derives its name. It has never been cultivated to any extent in this country, although it has been introduced into Europe, and successfully cultivated in England. From prejudice or other cause, however, the foreign article is generally preferred. Our annual importation exceeds $60,000 in value; while, so far as respects climate and soil and other conditions favorable to its production, there is no good reason why all the rhubarb required for medicinal purposes in this country should not be produced here. The effort of the Department, in antic-

ipation of the requests of many correspondents, to procure seed, is with a view primarily to encourage attempts at culture in the Southern States. Whether it would succeed at the North, whence many inquiries respecting it have come, the Department has not ventured to express an opinion. The question can only be answered by experience.

ALFALFA IN PERU.

A letter to the Department from the United States consul at Lambayeque, in Peru, states that in that region the Alfalfa, or Chilian clover, is sown in beds, very level, from 25 to 40 yards square, with borders or embankments of a yard in width, to contain the water when irrigated, which is only a few days before cutting. The cutting is done with a coarse sickle, and very close to the ground, so that afterward, when the weeds have been plucked out and the square swept clean, the soil appears quite bare. The grass grows very thickly and strong, three and often 4 feet high. It will not bear water, an abundant irrigation or inundation rotting the tap-roots and causing the speedy death of the plant.

DIRECTIONS FOR CULTIVATING ALFALFA IN THE UNITED STATES.

The consul adds some directions which he thinks ought to govern the cultivation of alfalfa in this country. It should be sown, he says, on hill-sides, the earth having been finely pulverized and rolled. It should be covered by dragging a bush or a dried limb over it; or if sown before a rain, another covering will be required to preserve the roots well and strong. If it be cut with a scythe or mowing-machine, a few sheep may be advantageously placed in the field, to eat it down to the bare roots. He has never seen, he says, any grass more prolific or of better quality. Horses and cattle work well upon it, when it is cut in full flower and fed fresh, and thin cattle are ready for market after two months' feeding. In the mountains of Peru, sown upon side-hills, it yields abundantly under quite severe cold (with no snow, however) and five or six months' of daily and severe rain. "I have seen it," says our correspondent, "at 12,000 feet above the sea-level. Care should be taken not to injure the roots by turning cattle into the field while the soil is wet." The consul has promised to send to the department some of the Peruvian seed, in order that we may test its quality here and compare it with the foreign and domestic now in cultivation in this country.

CLIMATE OF PERU.

Lambayeque, the residence of the consul, is on the Pacific coast, in the latitude of about 5° south, and the climate possesses all the peculiar characteristics of a dry desert, where a shower of rain is a remarkable phenomenon, supposed generally to be concomitant with an earthquake. The consul says: "The climate of this region of the coast is, on account of the continual trade-winds that blow from southwest to southeast, and the proximity of the Andes range, exceedingly dry, no rain falling except a slight sprinkle for a few minutes two or three times a year, generally in the summer months of March and April. It has happened, however, during the last few years, that the wind has suddenly veered around to the north and northeast, sweeping over the coast the heavy rain-clouds from the region of the headwaters of the Amazon and the Planicie (Plain) of the Cordilleras, occasioning several hours of continuous and heavy rain-fall, and causing great damage to crops and habitations. This

has been owing, no doubt, to some cosmic influences in connection with heavy earthquakes and tidal waves, which have occurred at the same time, and which also have caused the ordinary coast currents in the Pacific, that run from south to north, to take for some time an opposite direction. All agriculture is therefore necessarily carried on by irrigation. The thermometer very rarely stands in the shade below 70° F. in winter, or about 85° F. in summer. The soil on the coast is alluvial, very deep and rich, and therefore producing very abundant crops of all tropical productions."

GINSENG.

The Department has been solicited by several correspondents to furnish information in regard to ginseng—*Panax quinquefolium*—with a view to the culture of the plant in the Southern States. These inquiries have been answered by statements, in the first place, that so far as the department is aware, ginseng is not cultivated at all in any portion of this country, the product depending entirely upon collections of the plant, which grows spontaneously and abundantly in the mountain regions; and in the second place, that the supposed medicinal value of the root is not now generally recognized, and that its value among us is wholly commercial, the collections that are made of it being exclusively for exportation to China, where it finds its only market. These collections are made principally in Pennsylvania, West Virginia, Ohio, Minnesota, and Michigan. The value of the exports already rises to nearly $700,000 annually; and it is worthy of notice, as there appears to be no limit to the demand, that without reference to the cultivation of the plant, which seems to be attended with peculiar difficulties, the product might be largely increased through these collections, which at the same time would afford remunerative employment to a needy class of persons, including women and children.

It is obvious that ginseng is a valuable commercial product, and that whether by cultivation or the present method of collecting the spontaneous growth, the production, for agricultural and economical reasons, ought to be and may be increased. Several attempts have been made in North Carolina to cultivate it, but the growth was so slow, and very likely the management so bad, that further effort in that direction was abandoned. In the dirt, as it comes from the digger, ginseng root is now worth 30 cents a pound. While in a green state, it is taken to a clarifying machine, where it is made almost as clear as crystal. When thus clarified it is worth $1.10 a pound. A North Carolina correspondent of the department is of opinion that if ginseng continues to improve in price, another trial of cultivation in that State will be made in a more methodical manner.

In answer to questions from the Department, as to the practicability of cultivating ginseng as a staple, in view of profit, a correspondent in Wisconsin says: "I am told by those who have tried to raise it, that it will not grow. It is a wild root, and the Indians say it takes from 10 to 30 years for it to mature. From the seed one man has spent hundreds of dollars in trying to cultivate it, but failed entirely." Our correspondents, in view of all available information on the subject, are advised, without waiting for new experiments in cultivation, to use all practicable means to encourage the production of ginseng, by increasing the collection of the spontaneous growth and thus adding to the agricultural wealth and exerting a beneficent influence upon the labor of the country.

SUMAC.

Numerous letters of inquiry in reference to the cultivation of sumac have been received by the Department, indicating an increased interest in the subject, and a purpose to introduce the culture into some of the Southern States. We have answered these inquiries, as in the case of ginseng, by the statement that there is no cultivation of sumac in any portion of this country, but that our home supply, which by the way is far inferior to the demand, is dependent entirely upon the gathering of the leaves of the plant, which grows wild in many localities. This gathering, we have been glad to learn, is becoming an increasingly important industry, especially among the colored population of the South. Until within a few years almost the entire amount of sumac used in the country was imported from Europe, and still an undue proportion of that which is consumed here is of foreign growth. The sumac of this country—that of Virginia particularly—has been pronounced superior to the finest Sicily, which, as is known, commands much the highest price in the market. This estimate relates probably to the tannin qualities of the article rather than to the coloring property, which in certain respects is equally essential. It is generally understood that the cause of the difference in price in favor of the Sicilian product is due to the coloring matter contained in the American sumac, which prevents the employment of the latter in the manufacture of white leather. The difference, however, in the commercial value of the Sicilian and American sumac is very considerable, and worthy of consideration. Believing it to be really an important industry, and one to which this department should render all the aid in its power, the subject has been referred to the chemist of the department for a thorough investigation, with a view to the improvement of the American method of manufacture, and of ascertaining, if possible, the true causes of the difference in question by an analysis of a sample of the genuine Sicilian product. The results of this investigation, with a statement of such facts in regard to the manipulation of the plant, including the Sicilian method of cultivation, as bear upon the subject, will be submitted to the public in a special report of the department.

NEW EGYPTIAN COTTON.

The Department has for some time been in correspondence with the consul-general of the United States in Egypt, on the subject of a new description of cotton alleged to have been discovered in Egypt and to possess some peculiarly valuable qualities. Occasional articles have been published in the newspapers, most of which have contained erroneous statements as to the origin, history, and characteristics of this new plant. The consul informs us that Mr. Jean Cartally, a Greek, living near Benha, in Egypt, is the individual who brought the discovery to the knowledge of the public, and who made the earliest experiments in its production. Five years ago, it seems, a Coptic Arab, named Asaad Mansour, found in his cotton-fields three plants that so much attracted his attention as to induce him to carry them to Mr. Cartally, who discovered that they were something new, and the next season commenced experimenting with the seed. As the result of his experiments there were planted in Egypt last season, with the seed of the new cotton, over 4,000 acres, of which 300 belonged to Mr. Cartally himself. The success or imagined success of the experiment may be inferred from the fact that this season Mr. Cartally commenced the sale of the seed at the rate of

$40 per ardeb (an ardeb is a little less than five bushels, or about 270 pounds), and before he finished selling the price had increased to $200 per ardeb.

It may here be remarked that the pure seed of the new cotton is now obtainable in Egypt at a moderate price, and that the department is only awaiting the results of this year's experiments in Egypt, and in this country also, to determine upon the expediency of making a purchase with a view to an extended trial of the new plant in the Southern States. The department received from Mr. Cartally, last spring, a small quantity of the seed, which was distributed among cotton-planters of South Carolina and Georgia, from whom we have as yet had no reports of results. Extensive experiments also have been made in Egypt the present season, so that the plant might be well tested in every variety of Egyptian climate. The department expects to be informed, at an early date, of the result of these experiments.

The new cotton is what is called in Egypt "Long-Staple Simouni," the staple being long and fine and of a yellowish color, but not very strong. It is claimed by some that it is very much injured by a moist atmosphere or rain. All the cotton of Egypt, as is well known, is produced by irrigation, and the plant is seldom, if ever, wet by rain, except very near the coast.

From recent letters from Egypt we learn that this is the season for gathering the cotton there, and that the ginning establishments are in full operation. Our correspondent is taking measures to obtain the necessary data for making a full and definite statement of the results of this year's crop. He intimates that the expectations which were entertained last spring have not been realized, and that in some cases the crop proved almost a failure. Contrary to the suggestion above referred to, he remarks that the plant seems to require a rich soil and "plenty of water." There seem to be peculiar conditions required for the cultivation that are not fully understood, or that are not met by the climate of Egypt. It is not impossible that these conditions may be more readily found in the cotton-belt of the United States than in Egypt. The department will avail itself of all the means at its command, and of all information within its reach, to develop the true qualities of this new product, and, if desirable, to introduce its culture into the United States.

INDIGO.

Several correspondents have called the attention of the Department to the subject of indigo culture, and asked for information concerning the production and handling of indigo; the latitude, quality of soil, &c., best adapted to it; the time and manner of preparing it for market; where seed may be procured, &c.

We have advised our correspondents that notwithstanding the fact that after a period of profitable culture the indigo industry in this country has come to be neglected, so as that it may be said it has almost died out, it would seem to be possible that if enterprise and skill were directed to the improvement of the methods of cultivation and manufacture, the production might again be made remunerative in our Southern fields.

At a former, and not very distant period, the culture of indigo was a profitable and material industry of the Southern States. For insufficient reasons, as it would seem, its culture has yielded to other products, more attractive, if less profitable. It is still cultivated in Georgia and South Carolina, but to a very limited extent. Previous to the Revolution its culture was stimulated by the fostering influence of the British

Government, under which the exports amounted to more than a million pounds annually; and it was as much a king in the southern colonies as cotton became after the invention of the cotton-gin and has since been in the Southern States. The colonies grew rich upon it. Subsequently, India was looked to for supplies, and at the commencement of the present century the export of indigo from the United States had fallen off from 1,000,000 to 6,000 pounds. It is an indispensable article, and of universal consumption, for manufacturing as well as domestic pnrposes, and the department is disposed to render all the aid in its power to the revival of its culture. Having been advised by a correspondent interested in indigo culture, that the indigo of New Granada bears the highest price in the English market, the department has taken measures to ascertain from authentic sources the stock from which the New Granada indigo is obtained, what its peculiar properties are, to what extent it is cultivated, whither it is exported, and what its comparative value in the market is; and also to ascertain whether a quantity of pure seed can be obtained for the purpose of distribution here.

CULTURE OF THE OLIVE.

The cultivation of the olive in this country—or, more properly speaking, the revival of the cultivation which, having been commenced a century ago, has for a long time been neglected and almost entirely abandoned—has of late attracted considerable attention, and led to repeated requests from correspondents that the interest and active aid of the department might be enlisted in the matter. Believing it to be a question of importance, the Department has been disposed to respond to these requests; and although lacking the means of making an adequate effort, has taken some steps toward encouraging individual enterprise, by endeavoring to procure from the olive countries of Europe a supply of cuttings of good varieties for propagation here.

Our correspondence upon this subject has elicited some interesting information in regard to the culture of the olive in this country, especially in California, where it was planted in the old Missions, but where comparatively little improvement has been made in the culture by the introduction of the better kinds of fruit. Among the letters received by the department is a very interesting one from Mr. F. A. Kimball, of National City, San Diego county, California, who informs us that upon his first arrival in San Diego, in 1868, he found the remnants of an olive orchard, planted a hundred years ago, lying entirely common, and overrun by stock of all kinds. "Such of the trees," Mr. Kimball says, "as had not been destroyed by the camp-fires of the United States soldiers, who were for a long time quartered at the Mission, were browsed by cattle, horses, and sheep, and the ground at their roots burrowed by badgers, skunks, squirrels, and mice. The tenacity with which the trees had clung to life, and the luxuriance of some which had been protected by the cactus that had grown up around the trunks, convinced me that the olive was adapted to our climate and soil."

Mr. Kimball informs us that he set some cuttings in January, 1869, which blossomed in March, 1872. Subsequently, he set a large number which bore fruit in the fourth year, one of them about five gallons; and in the fifth year they averaged about that amount, one yielding twelve gallons.

As proof of the tenacity of life in the olive, Mr. Kimball states that his nursery of cuttings was in a very unfavorable situation, and that the entire surface soil had been removed in grading the lot, exposing a red,

adobe subsoil, in which the cuttings were planted in pieces about a foot long; notwithstanding which, about two-thirds of them started the first year, and in the course of five years and three months one put out a shoot that grew vigorously. Four years ago a tree in the old mission orchard produced 192 gallons of fruit.

Mr. Kimball expresses a confident opinion that the olive tree can in ten years be made to exceed the value of the wheat crop of California, provided that the best varieties can be secured and the best methods of making oil and pickles be ascertained. Mr. Kimball has now planted twenty acres, all of the Mission olive, which he proposes to bud with better kinds as soon as practicable.

In response to Mr. Kimball's request for information in regard to the manufacture of oil from the olive, the best kinds of fruit for oil, and the best methods of propagation, the department has furnished all the data within its reach. The manufacture of olive-oil is a process of great simplicity, not very unlike the operation of making cider, so familiar to all agriculturists. In most of the olive countries of Europe the process has undergone little improvement for ages. The description of Pliny would answer tolerably well for the method at present in vogue. But we can not doubt that the ingenuity and skill of our countrymen will soon discover, in regard to the olive—what is universally true—that there is no industry which may not be made more profitable as well as more easy by the improvement of appliances, and the substitution of mechanical power for manual labor. It is a significant fact, that in those countries in which the olive-oil has the highest reputation, the cultivation and manufacture are conducted with improved machinery and with the greatest care and intelligence.

Mr. Kimball's experience proves conclusively that in California at least we have the requisite climatic conditions for the successful cultivation of the olive; and that nothing is needed to insure commercial as well as agricultural success but a replacement of the old Mission olive by well-tested varieties from Europe, the products of which now command our markets and force us to an annual importation of half a million of dollars. The department is without the means of affording efficient aid to the laudable undertaking of Mr. Kimball, and of others in the same direction; but is now in correspondence with parties in Europe with a view of ascertaining the practicability of procuring from thence a supply of cuttings of such varieties of the olive as are of approved value.

BEE-CULTURE.

The active attention of the Department to the bee-keeping industry has been solicited, and the appointment of a commission recommended, for the purpose of gathering statistical information as to the condition and growth of bee-keeping in the United States, of communicating with the largest and most successful bee-masters, and securing their methods of wintering and otherwise managing bees, of testing all the modern and improved apiarian appliances, and recommending such as are worthy, of improving our common black bees by Italianizing them, of pointing out the most favorable bee-ranges in the country, of encouraging the cultivation of honey-producing plants, and of educating bee-men to use caps and crates of uniform size for commercial convenience. This measure—embracing so much that is of admitted importance to the bee-keeping industry—has been urged upon the department by the argument that the industry has suffered great neglect, and that, had the same efforts been put forth to foster and promote bee-culture that beet-sugar, sorghum,

and the like have received, the production of honey would by this time be simply enormous; many people who are idle for want of occupation would now be profitably employed, and this great wealth of nature, now comparatively unutilized, saved.

The department has replied to these earnest solicitations by assuring correspondents that it had neither the means nor the power to organize such a commission as was contemplated, while admitting that bee-culture was certainly an important industry, and highly deserving of encouragement; but suggesting that the efforts which have been made to foster and encourage it were underestimated; and that beet-sugar and sorghum, so far from having received undue attention, were yet in embryo, as it were, awaiting that concentrated interest in their behalf which is essential to their full development, while bee-culture, which is an industry accessible to individual enterprise, and much less dependent upon combined effort, has made good progress, as may be inferred from the thousands of bee-colonies now in profitable operation throughout the country; the improvements that have been made in the construction of hives; the new breeds of bees (particularly the Italian) that have been introduced; the formation of a national bee-keepers' association; and finally, from the numerous periodical journals and other publications exclusively devoted to the management of bees, including an annual "Year Book," in which are found the results of the observations and experiences of the best apiarians and naturalists.

CULTURE OF THE ENGLISH WALNUT.

A correspondent in Texas, Mr. John P. Lawrence, of Dallas County, who is a large landholder and an extensive and very enterprising farmer, has co-operated liberally and successfully with the Department in the introduction into Texas of new and valuable cereals, grasses, &c., and in the development of the agricultural capabilities of that State. Among other enterprises, he has introduced with good results the culture of the English walnut, beginning three years ago with a small quantity of seed, which the department was glad to furnish him in aid of his zealous effort. A few dozen nuts were sent to him from a tree growing in the garden of the late Hon. Peter Force, in this city, planted by Mr. Force himself, between forty and fifty years ago, and at this day a thrifty tree, at least sixty feet in height, yielding fruit abundantly every year, to the extent sometimes of several bushels. It is here known as the English walnut, but is really a native of Persia, and perhaps, also, of the north of China. In England it bears the name of the Royal Walnut (*Juglans regia*). It is a useful and beautiful tree, and the fruit has a high commercial value, as is indicated by the extent to which it is found in our markets, our supplies being chiefly, if not wholly, of foreign importation, while it is easy of cultivation, and many portions of our country are adapted to its growth. It has been cultivated for a long period in England, as well as France and Germany. In this country its cultivation is limited to an occasional tree here and there, with the exception of California, where it is largely grown. In the Northern States it is found to bring its fruit to perfection. Further north than Philadelphia, however, however, it does not produce fruit abundantly. It will thrive in almost any soil which is free from stagnant moisture, and is believed to be exactly adapted to the climate of Texas. Mr. Lawrence writes us that his plants are growing finely, and that he is fully convinced that his experiment will prove a success. One at least of his young trees is now, in its third year, three inches in diameter.

A NAME FOR AN "UNKNOWN DISEASE."

In the annual report of the Department for 1876 an "unknown disease" was referred to as prevailing among cattle in certain counties of Iowa, Kansas, and Nebraska. In all these localities, as was remarked, the disease was attributed to feeding on smutty corn, or dry corn-fodder, or the excrement of grasshoppers on the fodder. A correspondent in Kansas, Mr. E. Caulfield, of Vermillion, has communicated to us his views of this disease, ascribing it to what he believes to be the true cause, and giving it a name by which it may be hereafter characteristically known. He says:

This "unknown disease" is in the report attributed to cattle feeding on smutty corn, or dry corn-fodder, or the excrement of grasshoppers on the fodder. It cannot be the result of the first above-mentioned causes, for cattle will *never* eat smutty corn when other feed is attainable.

It cannot be the latter of the above-mentioned causes, for my attention was first called to this ailment among cattle in the fall of 1872, a year when we had no grasshoppers in this part of Kansas.

Therefore we trace it directly to the second of the aforementioned causes, viz, feeding on dry corn-fodder. But dry corn-fodder would not injure cattle if it was not the fact that it is *too dry*, that is, dry feed without any water to quench thirst.

My attention was first directed to this disease, if disease it may be called, in the latter part of 1872, by finding several head of cattle—ten, I think—lying dead in a stalk-field. After driving out of the field all that were able to move, I then looked after the water supply, and found that the creek, at which the cattle had been accustomed to drink, was entirely frozen over, so that the water was inaccessible to the cattle. A few days after this occurrence, the remaining cattle, one hundred or more, were turned back into the field, and the ice cut every day, so that they could obtain water; and the result was that no more dead cattle were found in that field.

The winter of 1875 was an exceptionally dry one in this part of the State, and when cattle were turned into the corn-fields they began to die off at a rapid rate, and in every instance it was found that in those fields where the cattle died there was no water obtainable.

Again, in the fall of 1876 in some localities I heard of cattle dying in the corn-fields, and on investigation I found that in every field where cattle had died there was no water supply for them.

Hereafter, when I shall hear of stock dying in corn-fields I shall not ascribe it to "an unknown disease," but shall simply say "they died of thirst."

FLORIDA—SEMI-TROPICAL PRODUCTS.

The Department has many inquiries concerning the climate, soil, productions, and agricultural conditions of Florida, which it is not always possible to answer with due intelligence and entire certainty. Many emigrants from the North and Northwest are being attracted thither by a genial climate and its presumed adaptation to the cultivation of semi-tropical crops. Exaggerated and doubtful statements are circulated from interested and partial sources, which are calculated to mislead and to create disappointment. The department is desirous, therefore, to obtain authentic and reliable information, that it may be able to answer satisfactorily the inquiries that are so frequently addressed to it. A recent letter from a correspondent in Tampa, in the southern part of the State, contains statements that deserve the attention of emigrants. The writer says:

The soil here, as I learn from those who are practical farmers, from the various States of the North, West, and East, requires an entirely different treatment from that of the States from which they come; and they seem to be as much at sea as myself—a novice—who unfortunately have none of their experience. This part of the State, South Florida, has not been developed, and as a matter of course we, as new comers, have no advantage of the experience acquired by settlers who have preceded us. We must take new land or none, as there is none which is in a state of even moderate cultivation.

This condition of things is, as I suppose, due to the fact that the country hereabouts until recently was in the hands of the Indians. The soil is thin and shallow, caused by a habit among the country people of burning the old grass that the new may grow, by which means whole tracts of country are laid in an almost barren waste. This is done to make grazing pasture for cattle, which are generally poor, scrawny, and stunted, such as any Northern farmer would feel ashamed of. These poor animals are turned loose in the woods, there being few clearings, to pick up a living as best they can, little or no fodder being fed to them. Such is cattle-raising in South Florida. If the droppings from the trees, thus eaten by the cattle, and the old grass, were allowed, from year to year, to rot and go to mold, the soil would be as deep and as good as any; but constant burning keeps it poor and thin. This is without doubt destined to be a great and wealthy country. It has all the elements of success, and those of us who are here must do our utmost, with the valuable aid and advice of your department, to secure its full development.

The following are extracts from an interesting letter addressed to the Department by Henry S. Sanford, esq., in reply to a request for information in regard to his experiments in the cultivation of semi-tropical fruits in Florida. It will be seen that Mr. Sanford looks confidently to the success of his own enterprising efforts, and to the ultimate full and profitable development, under proper direction and encouragement, of the semi-tropical advantages and capabilities of Florida. He says:

I have been engaged since 1869 in the culture of oranges, lemons, &c., on my grant in Orange County, on the upper Saint John's River. It took two years and $30,000 expenditure to satisfy me that all land in Florida was not fit for orange culture; on the contrary, that the land best adapted to it was in comparatively limited quantity. While my original grove of 100 acres, "Saint Gertrude," is not abandoned, but is continued, though less successfully, and with the advantage of more experience, I am having very great success on another, "Belair," of 125 acres, which is on high ground, with light friable soil, and there I am testing a great variety of semi-tropical plants, with a view to their permanent introduction in Florida. Your department has kindly aided me in this work by sending me the past spring many plants which, under the eye of a skilled horticulturist, will have careful attention, and, I hope, with useful results to the South. It is too early to give them now; next spring, however, I propose furnishing a report in detail.

I am doing on a small scale what Congress should provide to have done extensively under the auspices of your department; and the country, especially the Southern States, would reap a rich harvest in return. There are numerous products that we now import at great cost which I am satisfied can be raised in the South with great profit, but the people need to be authoritatively informed what they can raise to advantage, and the same facilities given them in the distribution of seeds, plants, &c., adapted to Southern culture as are given in respect to Northern products.

For the culture of the *orange*, Florida has greater advantages than any country I have visited, in soil, climate, and market. Unlike to Italy and Sicily, where artificial irrigation is necessary throughout the summer—for five months in fact—the winter is the *dry season* in Florida, while the copious summer rains render artificial irrigation unnecessary. Its fruit, too, is of superior quality and flavor, and is destined not only to take the place of the imported orange in the vast market of our own country, but will, doubtless, also be in demand for export to those countries now supplied by the inferior Mediterranean fruit.

I have introduced from abroad a large number and in every attainable variety of the trees of the citrus family, expecting to improve those worth preserving by culture in our superior soil. The cultivation of the orange in Florida, till lately, has been rude and confined mainly to seedlings of hap-hazard varieties, but as it is prosecuted on a larger scale for commerce, will be of choice and known varieties and distinct grades, and therefore, propagated by grafts or buds, securing quicker returns, and giving trees by their size and absence of thorns better adaped for commercial purposes.

With regard to the *lemon*, which is even more profitable than the orange, I think its culture for commerce, save in exceptional locations, can hardly be safely undertaken north of the twenty-ninth parallel, as it is less hardy than the orange. My experience is, that the lemon grown from the seed is less fit for commerce, because, with its thicker rind, more subject to rapid decay than the hard, thin-skinned Sicily lemon, so called, which we import from the Mediterranean, but that the same fruit can be produced from the imported trees. These I have introduced largely, and am quite successful in propagating from them on the native orange "sour stock," so that I feel quite assured that the lemon, as well as the orange, can be raised in Florida, and doubtless will be (for the profit is very large) sufficiently to supply our home market, which now absorbs imported lemons by the hundred million.

Pine-apples do well in my region in Florida, and bid fair to become an important article of commerce. After cultivating a few with satisfactory results, I am now extending that culture, have introduced many varieties from different countries besides the West Indies, and have in culture some 10,000 plants.

With the *banana* I have not been successful. I imported largely of choice varieties, but found it difficult to acclimate them or protect them from our slight December frosts, and I have abandoned that culture. Some of my neighbors continue it, with varied success. It is not a certain crop.

The *olive-tree* thrives well. I have a small grove of 50 trees, which will fruit next year, and I do not doubt this important and profitable culture can be as successfully prosecuted in Florida as in southern France and Italy. Care should be taken in selecting the variety best adapted for the soil and climate of the locality. Those planted from seed are next to worthless, save as stock for grafting.

The *vine* does extremely well. I commenced with some of our native varieties, and a thousand or so of the Delaware and Concord vines gave ripe fruit the first week in June. But I have concluded to raise finer varieties, only cultivated under glass at the North, and expect next spring to ship Black Hamburg and others of that class to the northern markets.

The *tea-plant* does well with us. I have but few specimens, but enough to prove its adaptability for our soil and climate, and I observe by a recent letter to the South Florida Journal (published at Sanford) that it was of excellent flavor, as the writer attested after drinking a cup at Belair, where it is in use.

My experience with the *coffee-plant* has not thus far been satisfactory. I imported a few hundred, and also received a few specimens from your department, but they were not properly cared for, and I propose giving this important plant a fair trial, and believe it will succeed. I observe in a local newspaper mention made of a family near Tampa that raised coffee for its own consumption.

The *esparto grass* (*stipa tenacissima*), so largely imported from southern Spain and from Africa for paper manufacture, I have tried on a small scale, and do not doubt that this product, whose consumption is measured by the hundreds of thousand tons, can be successfully raised throughout the lower tier of Southern States. The costliness of the seed alone prevented my introducing it gratuitously and widely, as I have done the *Eucalyptus*. It is of slow development, but once started grows on luxuriously without culture for generations.

That more valuable tree, the *Eucalyptus*, I introduced several years ago, and distributed to all applicants some 1,200 packages. It generally thrives well. In my locality its growth is amazing; trees in my place have gained 10 feet in height this year.

My suggestion to you is that you recommend the appropriation by Congress of the means necessary to form an establishment in Florida for the purpose of introducing such economic plants as are found to be suitable for culture in the South. There are a vast number of foreign semi-tropical products, drugs, gums, oils, &c., for which we pay large sums, which we can raise perfectly well ourselves; and again, I would wish to see something done to encourage immigration from Southern Europe. We erred egregiously a few years ago in discouraging the Italians who commenced flocking to our shores, and who would be of more importance to the South in introducing the culture of the vine and olive, and the other finer cultures of their country, than the North Europeans; and that culture should be made second only to cotton and sugar in importance and value among semi-tropical productions.

JUTE IN SOUTH CAROLINA.

Some of the rice-planters of South Carolina, as we learn from a correspondent who is located on the North Santee River, are apprehensive of danger to that crop from the admission free of duty of rice grown in the Sandwich Islands. This danger, he says, is regarded as so imminent as already to have occasioned a decrease in the acreage of rice-lands planted. Some of the planters have determined to substitute the cultivation of jute for that of rice, for which experiments have shown their rice-fields to be well adapted. And merchants of Charleston having become satisfied that jute can be successfully grown in that region have decided to start a bagging factory, and thus to open a home market for the jute. Our correspondent, who has made a successful trial of jute, gives us the result of his experience as follows:

The interest that you have manifested in behalf of the South induces me to suggest the culture of jute as the plant best suited to take the place of rice. During the years 1872, 1873, and 1874 the experiments I made with seed received from your department

resulted in establishing the fact that the plant was well suited to our climate. It was not until 1874 that I succeeded in getting the plants to mature seed. Former plantings grew vigorously, attained a height of 10 feet, bloomed profusely, and produced a fiber pronounced by judges equally as good as Calcutta jute. Yet the experiments were failures, as the seed did not mature.

In 1874 I planted on the 15th of April (other plantings having been made in May and June). The seed germinated in about nine days. When the plants were 6 inches high those intended for seed were thinned to two stalks 2 feet apart by 3 feet. When 18 inches high they were reduced to one stalk to the hill. The others were thinned to one stalk 6 inches apart by 3 feet. The seed-plants commenced branching when about 3 feet high, and attained a height of 11 feet. They bloomed profusely and matured a heavy crop of seed. Those plants left thick bloomed well and grew equally as high, but produced no branches and matured no seed.

These experiments establish several facts that will be of service to those who may cultivate jute as a crop. First, seed-plants should be planted in April, and have plenty of space. Second, for a crop the seed should be planted in May, thinned to 6 inches by 3 feet, leaving a single stalk in the hill. This crowding is important, as it is not desirable to have market-plants producing branches, since the bark has to be peeled from the stalk by rotting the stalk in water, and branches interfere with the peeling.

In this section of country May appears to be the proper month to plant, as the young plants escape the heavy winds of April. Third, the time for cutting should be when the plants are in bloom; at that season the fibre appears finer and stronger. The fiber of those plants that matured seed was coarse and brittle, apparently suited only for coarse materials.

I have had no experience in preparing the fiber for market, but know we possess great advantages over foreign producers, as their crops have to be taken to vats to have the stalk rotted, while in this country the construction of our rice-fields will enable us to flow the fields which grow the jute, and hold the water until the bark is ready to be peeled from the stalk.

Since the merchants of Charleston have become satisfied that this plant can be successfully grown in our climate, a few of our most public-spirited have decided to start a bagging-factory. This will open a market for jute, and the times appear propitious for the introduction of a product that must ultimately prove invaluable to our country.

SUGAR-CANE IN MISSISSIPPI.

Experience is indicating, if it has not already proved, that the sugar-cane region in this country has hitherto been confined to too narrow limits. A correspondent of the Department in the county of Lauderdale, Mississippi, whose location is considerably north of the supposed sugar limit, informs us that he has planted the cane very successfully for several years, and that he has found it a sufficiently profitable crop to induce him to continue and to extend his operations. We subjoin his relation of his experience. He says:

I live about latitude 32°, and some years ago—I mean a period before the war—it was not supposed that sugar-cane could be raised here; but the experience of the last eight or ten years shows that it can be grown successfully as far as one degree farther north than this, and that it is a far more remunerative crop than cotton. This year I planted two acres in what is known as the "purple" Louisiana cane. The land, rather thin and sandy, was on a small branch, and would not have made at best *more* than 700 or 800 pounds of seed-cotton, or 20 bushels of corn, to the acre. I planted the land with cane that I raised the year before, using on the two acres about 6,000 stalks. I planted in rows 6 feet apart, and manured with 100 bushels cotton-seed to the acre, costing 12½ cents per bushel. I planted on the 17th of March. I cut and ground the stalks on one acre, reserving the remainder for seed-cane, and ground the cane on a Victor sugar-mill, making the juice into sirup with a Cook evaporator. I made from the acre 310 gallons of excellent molasses, which I sold readily for from 55 to 60 cents per gallon. I am so well satisfied that it is a paying crop that I intend, next season, to plant four to five acres, if my seed-cane is sound in the spring.

Sugar-cane is cultivated also in the adjoining counties to a limited extent, and its cultivation is greatly increasing. Most of the cane grown here is what is called the "purple cane," but some of the "green cane" is also planted. This makes a much larger stock than the "purple," but is said to be not so hardy and easier killed. I have never planted it, and know nothing of it except from report.

As long as molasses remains at its present price sugar-cane here is quite a profitable crop. I have cultivated it more or less for four years, and have never had any trouble in saving seed.

CINCHONA IN THE UNITED STATES.

A correspondent in Elk Grove, Sacramento County, California, inquires whether an attempt has ever been made to naturalize the cinchona in the warmer parts of the United States; and whether it is probable that the tree could be raised in California, the climate of which, he remarks, "is suitable for oranges, lemons, figs, olives, and other tropical fruits"; and, proceeding to reason upon th[illegible] erroneous basis, he urges that our government ought not to be be[illegible]t of England, which has successfully introduced cinchona into its [illegible] and West Indian colonies.

We have advised our correspondent of the unsoundness of his position in regard to the climate of California, and that oranges, lemons, figs, and olives, not being tropical fruits, afford no criterion of climate in the premises; and, further, that if our government had tropical climates within its control, as has that of England, it might with some propriety be urged to make efforts to introduce tropical plants, and especially such plants as are peculiarly valuable, and strictly tropical, as cinchona is believed to be.

The various climates of our widespread country, however, embrace no locality that can be called tropical, and that is adapted to the cultivation of tropical products, whatever may be the range or degree of temperature. It is alleged, we know not with how good reason, that there are localities in California and Florida where frost is never experienced; and hence the conclusion is ignorantly or unadvisedly reached that all the conditions of a tropical climate exist, and that the productions of such a climate are possible. This quite common error leads to embarrassment, and often to disappointment, and, as the department has frequent occasion to notice, gives rise to inquiries for information and to requests for seeds and plants, which would otherwise be avoided. There are other conditions of vegetation within the tropics than that of mere absence of frost, conditions upon which plants strictly tropical absolutely depend, and in the absence of which, whatever the temperature may be, they cannot be expected to succeed. It has been stated that in some of the most southern counties of England an occasional winter will pass without the thermometer ever dropping below the freezing-point. Still it cannot, we think, from this casual occurrence, be concluded that England, or any portion of it, has a tropical climate.

With regard to cinchona, the Department has in former years grown plants of several species, and distributed them in Southern California and in several of the Southern States, more particularly Florida. The results of experiments made with these plants have been in all cases unfavorable, owing to adverse climatic conditions, showing that the plant will not stand the slightest degree of frost without injury. The locality of San Diego, Cal., is the only one in the United States which affords any promise of success, and the uncertainty and doubt in respect of that would not warrant the department in a continuous effort to introduce the cultivation. In a word, after many years of trial, the department considers the prospect of successfully growing cinchona as being too unfavorable to authorize any further distribution of plants, or any special attempts to establish its production among us.

PRICKLY COMFREY.

We have had many requests from different sections of the country for seed of the prickly comfrey (*Symphytum asperrimum*), a coarse-leaved

plant, remarkable for the prickly bristles with which it is closely beset, which has long been known and frequently recommended as a forage plant, but for some reason never generally cultivated. We have advised correspondents that we were not able, from any experience which the department has had with it, to speak with much confidence of its value as a forage plant. [illegible] said to eat it and to thrive upon it with apparent good effe[illegible] he [illegible]eld is described as being ordinarily very large—someti[illegible]; but it has not taken a high rank among our forage [illegible] new interest appears, however, to have been awakened in [illegible] our correspondence indicates, not merely in this country, but ab[illegible]d especially in Australia, where agricultural enterpris[illegible] aliv[illegible]erything that holds out the promise of improvement.

The prickly comfrey is a Caucasian plant, which was introduced into England from Russia many years ago. In its native country immense herds of cattle and flocks of sheep were entirely dependent upon it for sustenance; and its large and succulent roots were frequently eaten by the inhabitants. It is not easily propagated by seed, which may be one reason for its not receiving more attention. This difficulty has been overcome partially by the use of cuttings, but effectually by a system of dividing the roots, by which means the plant may be indefinitely propagated with great ease. A fresh impetus has been given to the culture of the prickly comfrey in New South Wales, Queensland, and Victoria, as we learn through our correspondence with those colonies. Mr. Guilfoyle, the director of the botanic garden at Melbourne, Victoria, writes that he considers it a very valuable fodder plant, "even if we take a moderate estimate of its productive powers—yielding, as it is said to do, more than 80 tons to the acre. It is also recommended for its extreme hardiness, neither heat nor cold being prejudicial to its growth. In the hottest and driest summers of the Caucasus it yields fresh, green leaves abundantly.

There are several species of *Symphytum;* but the *asperrimum* is that which is preferred for forage purposes.

In England a general interest in the prickly comfrey seems to have been aroused by a statement of an eminent seedsman, that it would produce from 60 to 100 tons to the acre; that it is especially adapted to the feeding and fattening of stock, and for increasing the milk of cows; that it grows more rapidly and luxuriantly than any other green soiling plant; that it is a reliable crop, independent of weather and climate, growing as well in the hottest countries and driest seasons as in the highest latitudes; that it comes in earlier and lasts longer than any other crop; and, finally, that it makes a very nutritious hay for cattle, horses, and sheep. How far this glowing description has been realized in the experience of English culture we are unable to say; but this department is disposed to afford an opportunity for trial to many who have expressed a strong desire to make an experiment of the plant in this country.

MESQUITE, OR SCREW-BEAN.

A request from Dr. Schomburgk, director of the botanic garden at Adelaide, South Australia, for some of the seed of the mesquite, or screw-bean, known also as the Mexican gum-tree, induced the Department to make an effort, through one of its correspondents in Texas, where the mesquite grows abundantly and seeds profusely, to procure some fresh seed sufficient for Dr. Schomburgk's purpose of introducing it into Australia as a fodder plant. Although it has not been cultivated to any ex-

tent in the United States, the excellent properties of the screw-bean as a food plant have been fully recognized. Dr. Schomburgk's attention was called to the plant by the reports of Lieutenant Whipple's boundary survey, in which it was stated that the prosperity of his horses and mules, and the success, in fact, of his expedition, were dependent upon the screw-bean, which he found to be indigenous to and growing abundantly in Arizona. The screw-like pods, according to this report, were found to contain much saccharine matter, and were very nutritious, ripening at different seasons of the year, and were very abundant, each tree producing many bushels. Upon the presumption that these statements were reliable, Dr. S. had concluded that the introduction of the plant into Australia would be a great boon. He had previously received some seed from Dr. Hooker, of Kew Gardens, in England, but they had unfortunately been attacked by a weevil, and not one germinated. He entertained the belief that the havoc of the weevil was done on the voyage to Australia, and expressed a wish that we should obtain some fresh seeds, which he said might prove of great value to South Australia, where during the summer months food for cattle was very scarce.

It is found very difficult to collect seed which is free from weevil and other insects. The beans form a sweet and nutritious food, and among the Indians constitute an important article of diet. The long pods are dried and pulverized by the Indians, and kept in that state to be made into bread. If not thoroughly reduced to a powder so that the seeds are as fine as the pulp, they become a living mass, since from every seed will come forth an insect, a species of *Brudens*. The Indians, however, who fortunately are not over-particular in such matters, are accustomed to allow the insects to remain undisturbed and to form an ingredient of the bread.

The Department undertook at the instance of a correspondent in Texas, where the mesquite grows abundantly and seeds profusely, to procure for Dr. Schomburgk some fresh seed; but we regret to say that our efforts have been wholly unsuccessful. It may be remarked, as Dr. Schomburgk quoted Whipple's Boundary Survey as authority for the nutritious quality of the screw-bean and its value as a food for horses, that Whipple does not state positively that he fed his horses with the pods of the bean, although he leaves that to be inferred. It appears, however, that in consequence of his representations the English Government was induced to procure from Arizona several bags of the mesquite pods, which were distributed among the different botanic gardens of the English colonies. A letter from one of the superintendents of these gardens, that of Jamaica, West Indies, recently received by this department, contains some statements which although not conclusive as to the qualities of the mesquite, are worthy of consideration, and which we deemed it advisable to communicate to our correspondent in Australia. In this letter the superintendent states that, by way of experiment, he gave about a pound of the pods to a fine, healthy horse, and that on the morning of the third day, after the pods were given, the animal was found dead in the stable, under circumstances which left no doubt that he died from the effects of the pods.

Further evidence is, of course, requisite to establish the fact of the injurious and even fatal effects of the screw-bean. The department would be glad of any information relative to the feeding of horses and mules with the pods of the bean in Arizona or New Mexico, where the mesquite is abundant; and especially whether any well-authenticated instance can be found in which the death of a horse or mule was attributed to the cause in question.

According to the report of the Southwestern Boundary Commission, the mesquite flourishes in arid districts, and is very productive, the pods, 7 to 9 inches in length, growing in large clusters upon the same stem, and the fruit ripening at different periods of the year.

The mesquite has always been recommended as a very nutritious food for horses, and hitherto all accounts of it have led to the belief that in those parts of the country where it is indigenous it has been chiefly used for that purpose. In addition to its value for food, it also yields good timber, growing often to a large tree, and a gum which is almost identical with gum arabic, and is moreover an approved tanning material, the whole body of the tree being rich in tannin. An analysis of some shavings of the wood, made in this department, showed that, as compared with other tanning material, it was very valuable, yielding a considerably higher amount of tannin than many other products.

PRACTICAL FOWL-RAISING.

A correspondent in Charleston, S. C., Mr. Arthur P. Ford, informs us that there has been within the last two or three years a remarkable increase in the numbers of poultry and eggs produced throughout the Southern States. This gratifying fact has induced our correspondent to send us the following hints upon the subject of fowl-raising, which are presented as the results of his own experience and observation:

BREEDS.—The best breeds suitable to our climate are the Game, Black Hamburg, Spanish, Dominique, and the common Barn-yard, and also crosses between the Brahma and any of the foregoing. The large thoroughbred Asiatics do not thrive south of the thirty-fifth parallel of latitude; the climate is too warm for them; they may live two or three years, but their progeny invariably degenerates. This is now a very generally accepted fact among those who have had experience in raising fowls in the South for actual profit. The dark colors are the hardiest, and in every way the most remunerative. Light-colored fowls are generally delicate, and nearly always inferior layers and setters. Persons forming a stock from any of the six varieties named should be careful to select the dark colors. White fowls are very pretty for the fancier, but they are an injudicious investment for the ordinary poultry-raiser in the South.

HOUSES.—Fowls should in all cases, wherever practicable, be allowed to sleep on trees for the eight months from 1st March to 1st November; they enjoy the privilege very much, and are always healthy; whereas when sleeping in houses during this warm period they will be constantly liable to all the diseases that appertain to their kind. When the cold weather comes on they should be put into the house at night, as they will not lay well during the winter if exposed to the cold rain and ice. The house should be placed upon the highest part of the grounds assigned to the fowls, in order to secure thorough drainage. It should be built of inch boards, placed two inches apart, to afford good ventilation; the roof should be close, the floor covered with dry, loose sand, and the roost made of two-inch laths, and slipped between the openings, in order that they may be withdrawn frequently and cleansed with kerosene-oil. The house should contain nothing whatever except the roosts; no nests or boxes should be allowed in it; and it should be whitewashed at least twice during the winter, and the floor frequently cleansed and supplied with fresh loose sand.

LICE.—Red lice will infest a fowl-house, even during the winter, in the South, and will be principally found on the under sides of the roosts, in small mahogany-colored patches. These lice infallibly cause sore heads, swelled eyes, and the dangerous disease known to fanciers as roup; but are instantly killed, however, by applications of kerosene-oil; and for this purpose the roosts should be withdrawn and oiled at least every three weeks. When fowls have sore heads, caused by these lice, they will die, unless promptly taken in hand. A simple but infallible cure is to grease their heads daily for three or four days with olive-oil, and make them sleep on the trees in the open air. The large white lice will never be found on fowls that sleep on trees during the spring and summer months; but if allowed to occupy a house, these lice cannot be escaped, and the fowls will show their presence by appearing droopy, and having colorless combs and gills, and unless they are relieved they will die.

WATER.—Pure, clean drinking-water is absolutely essential to the health of all poultry; impure water is a prolific source of cholera in summer, and of roup in winter. During the cold weather a little red pepper put into the drinking-water of fowls will

be found beneficial. This is a good tonic, and warms up the hens and induces them to lay. Another excellent provision is to place at the bottom of the vessel of water a piece of assafœdita, which impregnates the drink with its tonic qualities and is very wholesome. Fowls drink but little water at a time, but they drink very often; and in the course of the day consume a surprisingly large quantity of it.

FOOD.—The food should be varied occasionally from hard grain, to flour or meal mixed with a little water, and should be fed to them principally in the afternoon, in order that they may have a supply for quiet digestion during the night. During the winter months fowls require more food than they do at other times, for they are unable to obtain insects, and the cold weather renders actually more food necessary. If fowls are fed well during the cold weather, they will lay well; but they will not lay during the winter without an abundant supply of food. Chandlers' scraps, or oil-cake, that can be obtained at all soap-factories at two cents per pound, will be found very valuable food, given two or three times a week, but if fed too freely it will scour the fowls, as it is very greasy. An abundance of green food, fresh grass, &c., is absolutely indispensable during the summer, and should also be given the fowls during the winter whenever practicable.

RANGE.—A dry range is essential; fowls will not thrive in damp localities or on dirty premises. They should never be allowed access to rotted manure heaps, as the ammonia generated by such heaps always causes sore eyes and, if continued, death. There is a very great difference between an ordinary stable, or cow-yard, and a compost heap; in the former the fowls obtain much food without risk, but in the latter the food obtained is always at the cost of disease.

SETTING HENS.—Hens should never be set between 1st May and 1st September, as the small lice will become troublesome during the warm weather; and the young chicks will not thrive. They may be set advantageously at any time between September and May; but the chicks will require much care and protection if hatched during the cold winter months. The hardiest chicks and most easily raised are those hatched during the months of February and March. Only the eggs of the finest, healthiest hens should be set, and particularly those from the best layers; but eggs from hens that have had attacks of roup should never be set, as the constitutions of such hens are always weakened by this disease, and the chickens will be liable to similar attacks. It is certain that only strong, healthy hens can lay eggs that will produce strong, healthy chickens. The nests should always be made on the ground, so that the eggs can obtain the natural amount of moisture essential to hatching; and never under any circumstances should hens be allowed to set or even to lay in the fowl-house. They should be taken carefully from the nests once daily, and given corn and water; but when hatching has actually commenced they should be let most rigidly alone.

CHICKENS.—The young chickens should be kept in coops for at least one month after being hatched, or many of them will be lost by injuries and various accidents. A little meat, finely chopped up and fed to them occasionally, will be found of great advantage. Only the largest, best formed should be kept for stock, and the inferior should be sold or eaten.

PROFITS.—A stock of three cocks and twenty-seven hens will be found very manageable and remunerative by any family in the country, and will yield an abundance of eggs and chickens for consumption and sale annually. The profits of keeping fowls in a practicable, ordinary way may be demonstrated by the following statement, calculated for a period of two years:

DEBTOR.

To 30 heads of fowls, at 75 cents per pair	$11 25
To allow 8 to die in two years and be replaced at 75 cents per pair	3 00
To 48 bushels of feed, at 50 cents	24 00
Fowl-house	5 00
46 dozen eggs for setting, at 15 cents	6 90
Balance of profit in two years	88 85
	139 00

CREDITOR.

By 277 dozen eggs, at 15 cents	$41 55
By 506 chickens hatched, less 100 died, say, 406 raised, at 20 cents	81 20
By manure saved in two years	5 00
By 30 head of fowls, at 75 cents per pair	11 25
	139 00

Thus, thirty heads of fowls will pay a clear profit of $88.85 in two years, or an average of $1.48 each annually. Good specimens of the breeds named will produce annu-

ally about sixty to seventy eggs each. The settings should average thirteen, and of these about eleven will hatch. The extension of poultry-raising should in every way be encouraged, as it increases the supply of good food at a very reduced cost.

NORTHERN AND SOUTHERN FARMING.

The Department is in frequent receipt of letters from temporary and permanent residents and new settlers at the South, which illustrate the singular fact, that while the southerners are peculiarly an agricultural people, they are habitually, or to a large extent, not merely indifferent and careless about the condition of their farms, but neglectful of the means, now more than ever within their reach, of improvement in methods of culture, and especially of those scientific and mechanical appliances by which the management of their farms might be brought to the higher and more profitable standard of northern agriculture. The cause of the unfavorable comparison of southern with northern farming has been at least partially removed; the material question of labor is adapting itself to the changed circumstances of southern farmers, and the time is propitious for a reconstruction of the South in the highest sense, by a careful practice of the arts of industry upon which her prosperity essentially depends. It is the aim of this Department to excite and encourage such study and practice, and to aid the South, as far as it can, in advancing to that high agricultural position for which nature has designed it.

A correspondent in Texas accompanies an application to the Department for seeds, with the following observations upon the farming of that section as compared with that of the North:

> A person of observation, traveling from the South through the North, cannot fail to notice the superiority of Northern farming and horticulture over those of the South. This is observable in the careful selection of seeds; in the thorough system of plowing, subsoiling, underdraining, &c.; in the farming implements and tools; in the rotation of crops; and in many other important and even vital things.
>
> Here, I am sorry to say, almost the reverse is the case. Any seed is thought to be good enough "if it will grow." I will venture to say there are not a dozen fanning-mills, outside of the grist-mills, in one-half that many counties in Northern Texas. I have seen old men who never used a two-horse plow or cultivator in their lives, and they were farmers, too; and I know men that, within a few years, cut their grain and hay with a sickle, having never heard of a grain-cradle. And there are those who are running farms of hundreds of acres with only a few one-horse plows, bull-tongues, cotton-sweeps, and hoes, not a grain-drill, harvester, cultivator, harrow, or improved plow being on their premises. This year I propose to subsoil and underdrain thoroughly a part of my farm at least, planting only the best home and imported seed, and that in the most approved manner. They say tame grass will not grow here. Please send some seed that I may try the experiment.

MISCELLANEOUS.

To the foregoing notices it may be added that the miscellaneous correspondence of the department has been very voluminous, embracing inquiries for information upon a great variety of topics, requests for seeds, plants, &c. It has been the aim of the department to satisfy these inquiries to the extent of its ability, and to respond to these requests as far as was compatible with its general purposes in the distribution of seeds. Specific requests, relating to chemical, microscopical, entomological, botanical, and statistical matters, have been answered by those in charge of the several branches of the department to which they refer, as will be seen from their reports. The attention which the department has bestowed upon the great industrial interests of sugar and tea culture have led to an extensive correspondence with planters, experts, and others disposed to engage in those industries, as will be seen from the special reports, which have been issued, devoted to those subjects.

Regarding the question of increasing and cheapening the production of sugar in the country as one of great national magnitude, the Department has lost no opportunity of awakening the public attention to the importance of the subject, and of furthering by whatever influence it could exert, and through whatever means it could legitimately command, every effort by which the object may be most speedily and successfully attained.

So with reference to tea. Letters from correspondents in various sections of the country have evinced an increased and earnest interest in its culture. The department has regarded the subject as an important one, and has given it serious attention. It is believed that the obstacles to the culture—regarded heretofore as insurmountable—have been, or may be, overcome; and that the culture and manipulation of tea in this country may be successfully established.

SOME FACTS IN REGARD TO THE CULTIVATION AND CONSUMPTION OF ORANGES.

Many of the Southern States have wonderful natural advantages in their capacity as to fruit-growing, and especially their adaptation to the production of the more valuable fruits peculiar to warm climates, such as the orange, the lemon, &c.

The cultivation of the orange in this country has been confined principally to Florida, Louisiana, and California, and the results have been so favorable that much attention has been attracted to the subject.

There is no reason why the area of its cultivation should not be extended, and that in other States of like climate and soil its cultivation should not be undertaken as a specialty and prosecuted to an important industry.

The taste for many fruits that are valuable and nutritious requires in many cases to be cultivated. Experience has shown that the demand for fruits has been equal to its increased production, and especially is this the case as to the more valuable fruits. There can, therefore, be no fear of an overproduction in such varieties.

The oranges grown in Florida, Louisiana, and California compare favorably in size, flavor, &c., with those imported from the West Indies and Europe, and each successive year there has been shown an improvement in the varieties by the graftings from trees of superior quality. As the knowledge of their culture increases the quality of the fruit will continue to improve, and in a few years the markets of the country will be supplied entirely from the Southern States and California, and the expenditure of nearly four millions of dollars per annum for importations will be saved to our people.

The difficulty in regard to orange culture has been the impatience for immediate results. The orange requires from seven to ten years of attention before it begins to bear, and the lack of patience and confidence deters the many from starting an orchard and persisting in its care.

The lemon is of the same family as the orange, and it has the same habits and requirements.

In an address before the State Agricultural and Industrial Convention of Alabama, at Blount Springs, September 4, 1877, Col. George B. Clitherall, of Mon Louis Island, Alabama, gave some experiences and facts on

the subject of orange culture in that State that may be of value to those engaged in or about to commence this industry, portions of which are transcribed for their benefit:

About five years ago I purchased a small tract of land on Mon Louis Island, in the Bay of Mobile, and about twenty-five miles south of the city. On this tract there were a few young orange-trees, and also a nursery, the trees being then from two to five years old. For a year preceding my purchase the place had been unoccupied. Hogs and cattle had trampled over it, and the trees and plants had been utterly neglected. I immediately repaired the fences, transplanted from the nursery, and planted with seeds from selected Creole or native oranges, believing I would secure a hardier, or, in other words, an *acclimated* tree. I then commenced a system of culture, which consisted in removing weeds and grasses, forking in ground bone, scattering on the surface partially-burnt oyster-shells, and mulching generously. The result of the culture was apparent in a few weeks, and proved most gratifying.

I have each year since planted out from my nursery, into orchard, from one to three hundred plants, varying from one to five years old. I have now about eight acres in cultivation, with 970 thrifty, vigorous young trees, about 150 of which are now for the first time in fruit, except ten or fifteen which bore a few oranges last year. The fruit was of large size and delicious flavor. One twig, containing nine oranges, weighed ten pounds.

I have heard and also read that orange-trees bear at five years old. I regard this a mistake, or, if it is ever true, I consider it to be only in exceptional cases. I think one who plants an orange orchard *in our* climate with the expectation of gathering a crop in less than ten years will reap only disappointment. I speak of seedlings.

Orange-growing as a vocation I find pleasant and interesting, requiring little capital in money, but a large investment of patience, industry, and careful attention. Bestow these and the reward is rich indeed. The orange-tree is very tenacious of life, but in its infancy and childhood needs parental nurture. Give it this, and long before maturity it will manifest its gratitude.

Under favorable circumstances and with careful culture you may expect your trees to yield, at ten to fiteen years old, an average of from 300 to 500 oranges each; at twenty years old, 1,000 to 1,500; at thirty years old, 3,000 to 5,000 per tree; and so on increasing in yield until trees are fifty or even one hundred years of age.

Now, let us figure a little on the premises as stated above; and I believe my figures are rather *below* than *above* actual results. An orchard of 10 acres, with 150 trees to the acre, is 1,500 trees; these at fifteen years old may be expected to average 400 oranges to the tree, or an aggregate of 600,000 oranges, for which, at two cents apiece, you have $12,000. At twenty years old you should gather 1,500,000 oranges, which at two cents each would realize $30,000. At thirty years old you may expect to gather 60,000,000 of oranges, yielding, at two cents per orange, $120,000. Truly a snug income as a reward for a few years of patient care and industrious labor.

After the orange-tree is ten years old the expense of culture is a mere trifle. Mulching burnt shells on the surface, removing sprouts and suckers, is generally all that is required. The cost of gathering the fruit and getting it to market being now the principal items of expense, if you desire to be rid of this trouble the fruit-dealers will gather your crop when they wish it for market, and pay you $10 per thousand, leaving you a net income of $60,000 from your ten acres. What business pays so well for patience, care, and labor?

The results of these figures may to some seem extravagant, but I am satisfied of the correctness of my premises; the calculations any one may verify.

Compared with foreign oranges ours are vastly superior in size and flavor, and the cost of their transportation to the Northern cities should be far less. Were this so, we would drive out all foreign importations so soon as our production was equal to the demand in our own country.

Adjoining me is "Orange Forest," the estate of the late H. B. Austin, a far-sighted and enterprising gentleman. From the manager of that orchard, Spencer Sharp, esq., a practical, intelligent, and every way reliable gentleman, I have gathered the following data, which I regard as interesting. Mr. Sharp said: I have lived on Mon Louis Island, planted and have been continuously engaged in the care of this orchard since 1848. I planted the seed of Havana oranges. The plants did well until January, 1852, when they were killed to the ground. The following summer most of them grew up from the old roots, one of which bore fruit in 1854. In March, 1858, most of the trees *bloomed*, but the severe frosts of that month killed the bloom, and we had no fruit till 1859, when, from about one hundred trees, I gathered 13,000 oranges. The winter of 1859–'60 was cold and unfavorable, and in the summer of 1860 we got very little fruit. "Scale" injured many of the trees. Since 1860 the trees have continued to increase in size and yield. At present several of them bear over three thousand oranges. We have gathered from 287 trees 220,000 oranges.

An extensive fruit-grower of Florida, at a recent meeting of the Fruit-Growers' Association at Jacksonville, in that State, said:

In former times, when our whole time and attention was engrossed in cotton and sugar culture, fruit-growing was looked upon rather with contempt, and the wild-orange groves were not valued any higher than the same quality of other timbered lands. Many of the finest wild groves were cut down and destroyed to make room for cotton and sugar culture, &c.; but of late years a new era has dawned upon our people, and they have awakened to the importance and profits of tropical fruit-culture, and now these wild groves are highly prized, and many of them have been and are being converted into sweet groves. I shall only give the plan we have adopted on Orange Lake, and, so far as I can ascertain, it is the plan generally adopted. We first carefully cut off with a chopping-ax all the orange-trees from three to four feet above the ground, and all the underbrush and smaller forest-timber, and pile everything in close, compact piles. We then cut down the other forest-timber and pile in like manner, and let the whole remain on the ground until it is decayed, which will only take a year or two, thus enriching the soil and taking care of part of the ground. In about a month after the orange-trees are cut off they are in good condition for spring budding or side grafting. We put one or more buds in each stump, then in two or three weeks' time we go over the grove, and from all the trees that have green living buds on them we carefully take off all sour sprouts or shoots, leaving only the sweet bud to grow, and keep off all the sour sprouts that attempt to grow until the sweet bud is large enough to consume all the sap of the stump, when the wild shoots will stop growing.

As the roots of the wild tree are not disturbed, it is obliged to make a large, fine, sweet top in a short time, to replace the wild top that has been cut off. I have a great many trees that bore fruit the past year, and some of them bore over a hundred oranges, that were not budded until late in the summer, making the trees a little over two years old from the bud when they first began to blossom for fruit. Trees can be found in my grove that are now only three years old from the bud that have sweet tops as large as any well-grown eight-year-old sweet seedling tree, and will bear as much fruit.

Do not plant any kind of crop among the trees that will exhaust the soil. Pease, pumpkins, garden vegetables, &c., may be grown in a grove without injuring the trees. The amount realized from other kind of crops will not compensate for the injury done the trees.

I may place too high value on wild-orange-grove lands, but I firmly believe that I would advise one who wished to engage in the culture of that and other kindred fruits, and had the means to do so, to give $500 per acre, if it could not be had for a less price, for good wild-orange-grove land well situated as to transportation, and a good water protection against the cold from the north and northwest, and with a good rich (but not a low, wet, heavy) soil, rather than take the same kind of land without the wild-orange trees for nothing.

And, now, let us see why I make such a difference. Take a wild grove and improve it like I describe above, in three years it will begin to bring an income, and say we only leave 100 trees on the acre, and that each tree will only net $1 per year for the first five years (which every one well knows is very far short of what will be realized from such a grove). Thus the grove will net $100 per acre per year, and in five years we have the original cost of the land back, and the trees will then have large fine tops eight years old from the bud, and will bear on an average at least 1,000 oranges apiece.

Now, take the same kind of land and plant it out in sweet seedlings. We will have to wait until they are at least eight years old, and many of them will be ten years old before they will begin to bear the first time; therefore the budded trees have from five to seven years the start of the seedlings in point of bearing-time. The wild-orange trees in their native state generally grow in thick dense groves, and in heavy-timbered hommocks, the dense shade thus excluding all sun and air, and therefore they only bear a small quantity of fruit. Whenever they grow where the sun and air can get to them they bear very full. Colonel Martin, of Marion County, had the fruit pulled and counted from a tree that grew out in his plantation, exposed to the sun and air, a few weeks since, and it had 10,500 oranges on it.

Mr. E. J. VANCE, of Madison, Fla., writing on this subject, says:

Orange culture has not been made a business in this county. Two or three gentlemen in the county years ago planted from an acre to three or four acres. On almost every farm a few trees were planted in the yard, which grew without any especial attention. Since the war, considerable interest has been shown in planting and raising orange-trees, and more care taken of those that had begun to bear.

The winters have been so severe that the seedlings have been cut down, the older trees suffering but little. I would estimate that there are about one thousand bearing trees in this county; that is, about twenty acres in trees. This is rather under than over the actual estimate. The oranges average two cents apiece. Allowing an average of five hundred oranges to a tree, the crop is worth annually about $10,000.

If we would take half the trouble with our orange-trees that the people of the North do of their fruit-trees, we could raise oranges in abundance and of excellent quality. A slight protection for a few days in winter to the very young trees would insure them against damage from cold. There has been but little trouble on account of the "scale" insect, and when there has been injury from that quarter it was from neglect.

In this county the increase of production since 1865 has been at least 100 per cent., and will gradually increase yearly. Numbers of farmers have from two or three to ten trees planted in the yard, and make enough money from their yield to pay their taxes, &c.

Mr. JOHN BRADFORD, Tallahassee, Fla., writes:

Until the last few years few or no oranges were grown in this county, and no pains taken to have the trees, as it was considered too far north for them to succeed. Then, too, cotton absorbed every thought. Many families kept a few trees more as an ornament than for expected fruit. These trees are now bearing finely, and in some cases are remunerative to their owners. The writer has ten trees bearing, from one of which were gathered three thousand oranges last year, and fresh, well-preserved fruit was gathered from one of these trees last week (March 1).

There are some dozen or fifteen small orchards in the county, but no large orange farms or orchards, though nearly every one who has a garden is planting a few trees, and in a few years the increase of this fruit in this county will be one hundred-fold.

Mr. HENRY J. STEWART, Jasper, Fla., writes:

Our county is supposed to be too far north to make orange culture a success; the consequence is that there are no orange groves in the county, yet there are quite a number of persons who have one, two, three, or four trees on their premises, and from them we can form an idea as to what a large grove would do. 'Tis true, that some of these trees standing isolated are killed off occasionally by the cold, but I am inclined to the opinion that in a large grove they would not be thus subject. The yield of a tree from six to ten years old is from one to three thousand oranges, worth from $20 to $30 per thousand.

Mr. SAMUEL B. PARSONS, a well-known and experienced horticulturist, of Flushing, N. Y., writes of orange culture in Florida:

When I visited Florida in 1846, and purchased Blue Spring, I found two orange groves only of any importance. One was that known now as Hart's Grove, opposite Palatka, and the other at Mellenville, belonging to Dr. Spear. Darinetti Grove, on Indian River, may have then existed, but I did not hear of it.

In 1853 I again visited the State and found very little change in orange culture. My next visit was in 1869, when I found a new interest developed and many persons were planting orange trees in different parts of the peninsula. Then came several winters of severe cold, and many plantations were destroyed, and the Saint John's River was lined with an array of dead trees.

Then came milder winters, the groves suffered little and made steady progress. Immigrants poured in from the North, and taking up the best lands planted largely of orange trees, and the area of orange culture increased beyond precedent. Large groves of wild orange trees were thinned out and grafted, and the wildest anticipations of profit indulged. The visions of the milkmaid were nothing in comparison. One hundred thousand oranges to an acre was a low estimate, and the actual prices obtained,—$25 per thousand delivered on the ground—gave a product of $2,500 per acre. Thus with ten acres a man could have an income of $25,000 per annum, with large possibilities of increase. Now these figures were based upon the actual product of individual trees and prices actually obtained. They were sufficient to stimulate planting in the highest degree. There were, however, two unknown elements which did not enter into the calculations of these sanguine planters—the risks of exposure and the risks of soil.

The destruction of many groves and the escape of a few by a sudden fall of temperature showed the importance of the right exposure. A large body of water to the northwest of a grove was a great protection, and many who thought that such a body of water was all they needed, settled on the rich lands upon the lakes of the interior. A severe winter destroyed their fruit and killed their trees, while the same cold did no harm to the trees on the east side of the Saint John's River, which had no larger stretch of water on the northwest. The cause of this was obvious. The Saint John's River takes its rise in the warm everglades, and innumerable warm springs add to its volume. This mass of heated water, rushing down through the narrow passes of the river as far as Palatka, there debouches into the broader lake-like stream. From this the heat radiates upon the east side, and protects the trees thoroughly from a sudden cold, sufficient to kill entirely all orange trees half a mile back from the river, or on the west side, or on the rich lands of the interior. This it is that makes the east side of the river for ten miles north of Palatka the best exposure in Florida.

Immigrants, however, rarely know this, and the result is that thousands of orange

trees are annually planted where they must inevitably suffer from those sudden accessions of cold to which the climate of Florida is always liable.

Should there be now a succession of mild winters, until these groves have attained size and the hardiness of maturity, there will be a probability of their escaping injury except to the crop, unless a frost like that of 1835, coming upon them when in full growth, shall sweep them off, root and branch. This contingency, however, is remote, and the present success and immunity from frost will extend the area of orange culture immensely.

I have spoken of the east side of the Saint John's River as having the best exposure for orange trees. Of its soil, however, nothing can be said in praise. The low hammocks are too wet, and the high hammocks are the siftings of creation. Of the pure, bottomless sand there is no hope, and much of the soil is of this character. There are, however, rare spots where the sand is underlaid with a yellow, aluminous soil, and in these the orange will grow luxuriantly. Give it a dressing of potash and bone and the answer will come in abundant globes of gold.

Trees will grow more luxuriantly in the richer lands of Alachua and Marion counties, but the danger there is greater from frost.

Immigrants know very little of these peculiarities of soil. They plant freely upon the worst, struggle for a while, and unless very fortunate, either sink into poverty or give up in despair and return home.

Notwithstanding, however, the danger of frost, the rich lands of the interior, west of the Saint John's River, will be the great attraction for orange culture. The certainty of growth with the possibility of frost will more than counterbalance the uncertainty of growth with the freedom from frost.

The area of land on which oranges will be planted is thus very large, and should there be a succession of mild winters to enable the groves to attain an age which will give comparative immunity from frost, the production of fruit will be enormous, and can be furnished at prices which will drive out the oranges from Sicily and Spain.

The wonderful productiveness of the orange tree will aid this result, and, like the small fruits of the North, this delicious product of a semi-tropical region will be enjoyed by the poor as well as the rich.

It being thus a foregone conclusion that the orange is a staple article of production, it becomes interesting to know what are distinct varieties.

I have planted in Florida over a hundred varieties of the genus *Citrus* sent to this country from Europe and elsewhere, few of which have yet fruited. I have also taken many of the so-called varieties which have originated in Florida, and, with few exceptions, can see no greater difference between them than between different fruits of the same variety on my own trees.

The finest-flavored fruit, and entirely distinct in its appearance and character, is the *navel* or *Bahia* from Brazil, which I planted in Florida in 1869. This has a mark at the blossom end like a navel, a fine texture, and while sometimes two or three seeds are found, is generally seedless. The flavor is sweet and spicy, and it is remarkable for bearing when very young. Its excellence is so well established that it is being planted largely in various sections.

A variety called the *Sweet Seville* is also highly esteemed. It is very small and of almost honeyed sweetness.

An oval variety is also distinct in form. It is early, and then good, but later in the season becomes dry and poor.

The *Excelsior* and *Saint Michael* have also fruited, but are not materially distinct from an ordinary Florida orange.

The little *Tangerine* or *Mandarin* of the Paris markets is very distinct. It is dwarf in growth; its habit is bushy; its form is flat; its skin comes off, and its sections fall apart almost at a touch. It is the very fruit for the gloved hand of a lady.

The *Sour* orange and the *Bitter Sweet* are distinct varieties and well known. Beyond these I have named I have not seen any varieties which are decidedly distinct.

Among the lemons I have introduced I hope to find some variety adapted to the climate. The Sicily lemon grown in Florida is thick-skinned and poor.

As my orange grove has been only an incidental pleasure, to be given up when interfering with my northern business, my tarriance upon it has been too short each year to allow me to give you an exhaustive essay upon treatment, insect enemies, and other matters. I can only say that in a life-long familiarity with trees I have never known any so infested as the orange tree. The small brown *coccus*, the large white *coccus* or *scale*, the slug, the elephant grasshopper, the worm at the root, the ants just at the surface of the ground, the mildew on the leaf, the die-back, and the rust on the fruit, all requiring vigilance and care.

The die-back, which has also made its appearance in Europe, is the most serious from its unknown cause. The cause of the rust on the fruit is also unknown.

All these things may be a temporary bar to successful culture, but the result must inevitably be that all the good lands on the Florida peninsula will be given up to orange culture, and that this delicious fruit will soon be as abundant in northern markets as strawberries in June or apples in November.

While the cultivation of oranges in California is of comparatively recent date, experiments have demonstrated that a large area of the soil and climate of that State is admirably adapted to the cultivation of a superior quality of this fruit. Mr. W. R. Olden, in a letter of recent date, published originally in the Anaheim Gazette, and copied into the Southern California Horticulturist, in speaking of the successful cultivation of the orange in Southern California, says:

I am not surprised that considerable interest is felt regarding orange culture in this section. For some eight years I have devoted considerable attention to this question. Eight years ago the almost universal prediction was that "when the young orchards now planted commenced bearing, oranges would be a drug and would be unsalable at a remunerative price." This looked reasonable; almost everything else in the way of fruit and farming had been overdone, and why not oranges? The prediction did not prove true. The average price paid for oranges at that time is not only maintained, but has advanced materially, showing that the demand exceeds the production now, and will continue to do so, as the area upon which they are produced is limited, being confined to the irrigable portion of Southern, and a few detached spots in the *warm belt* of Northern California.

Another fact of greater importance I have noted, and that is certainty of crops. While other fruits are liable to be cut off by frost, the bearing orange tree in this section, during eight years, has been uninjured by frost; the trees have not failed to produce. In this respect the orange takes the precedence of all other fruits, as it does in all others. *When ripe* the orange of Southern California is not only unsurpassed in flavor by oranges grown anywhere, but it also possesses an important advantage over oranges grown anywhere else, in the fact that when ripe the dryness of the skin enables it to be shipped with safety for long distances. The skin of all other oranges is very moist at all stages of their growth, and they cannot be shipped either ripe or green without injury and loss, both to flavor and quantity. And, moreover, our oranges can be permitted to hang upon the tree several months after ripening, not only without injury, but with improvement to their flavor. In proof of their ability to stand shipment, I will state that Dr. Shaw, of Los Angeles, when on his way to England, and while on the steamer from Los Angeles to San Francisco, was presented with two boxes of oranges by Mr. Wolfskill, who had a lot on board, packed without wrapping or other preparation, for the San Francisco market. This was, I think, in the month of June, 1871. Dr. Shaw went by Panama direct to England, and after his arrival the boxes were opened and the oranges proved to be sound and uninjured, after passing through the tropics. As I before remarked, they were without wrapping or other preparation. No other fruit in the world would have stood such a test.

With such undeniable advantages in its favor, orange culture now is, and will continue to be, the most profitable pursuit in Southern California for the above reasons, which I will recapitulate: First, certainty of crops. Second, unsurpassed flavor. Third, capability of being shipped when ripe without injury to flavor or loss by decay. This makes our market practically unlimited.

The statistics of the orange trade, both in this country and in Europe, bear out the statement that but few valuable fruits ever exceed the demand. The following table, showing the importations of oranges and lemons into the United States for the years named, and the consumption of the same, would seem to be sufficient proof of this:

Fiscal year.	Values.	Rates of duty—ad valorem.	Total duties.
		Per cent.	
1868	*$1,812,180 54	25	$453,045 13
1869	2,080,983 63	25	520,245 91
1870	2,418,667 97	25	604,666 99
1871	†2,874,742 34	20 and 25	602,087 34
1872	3,369,717 76	20	673,943 55
1873	3,085,659 91	20	617,131 98
1874	691,922 87	20	138,384 58
1875	4,233,325 24	20	864,664 99
1876	3,412,027 45	20	682,468 80
1877	3,073,304 34	20	614,660 94

* Including limes.

† During this fiscal year the duty was reduced from 25 to 20 per cent., ad valorem; hence part of the import duty was charged at one rate, and part at another.

The importations into Great Britain show that the trade and consumption in these fruits have more than doubled in that country during the past ten years. The following table is taken from official returns made by the British Government, and accurately indicate the increase in the trade:

Year.	Quantity.	Value.
	Bushels.	
1865	1,566,745	....
1866	1,711,857	....
1867	1,453,566	£744,732
1868	1,806,372	876,197
1869	1,939,363	927,804
1870	1,933,421	648,056
1871	2,376,831	1,008,954
1872	2,385,160	1,154,270
1873	2,308,208	1,120,309
1874	2,403,338	1,158,480
1875	2,861,719	1,336,247
1876	2,995,323	1,258,565

In 1870 the official returns of Great Britain give the following named countries as those from which their supplies were received:

	Quantity.	Value.
	Bushels.	
Portugal	273,296	£92,313
Azores	826,760	281,502
Spain	514,676	180,687
Sicily	287,909	83,823
Other countries	30,780	9,731
Total	1,933,421	648,056

The importations of oranges and lemons into France, from Spain and Italy, have increased in the last few years more than fourfold in quantity, and amount in value to more than 250,000 pounds sterling per annum.

From the Azores immense quantities of oranges are shipped to Great Britain and the United States, in the export of which 243 sailing vessels and 30 steamers are employed. This shows the importance of the trade to those islands. In 1876, 283,712 boxes of oranges were shipped from the Azores to Great Britain, and 6,798 boxes to the United States. A box may be said to contain three bushels of oranges.

It is said that in these islands the orange and lemon are cultivated with great care, and the branches and limbs of the trees are attended to so scientifically that they usually attain gigantic proportions. Single orange trees there have been known to produce 20,000 oranges at one crop.

The island of St. Michael ships to Great Britain and the United States over $300,000 worth of oranges per annum.

The orange groves in the French colony of Algeria are extensive, and afford a profitable industry to the people. The fruit has acquired in the market a reputation for excellent flavor, and has a ready sale. About 15,000,000 of oranges are exported in an ordinary season.

The exports from Morocco are also extensive, reaching over 1,500,000 per annum.

Sicily exports large quantities of oranges and lemons. The greater part of the lemons received in the United States come from Sicily, which

has heretofore almost entirely monopolized the industry of manufacturing the oil of lemon, of bergamot, and trade in orange flowers.

In New South Wales, orange and lemon culture are receiving much attention. In favorable situations these fruits attain great excellence. It is stated on authority of official reports, that one cultivator has realized as much as $7,500 per annum from three acres of orange-trees. The Mandarin orange has been introduced there, and is said to thrive well and produce better fruit at Sidney than it does at Canton. It is described as a very beautiful, dark, orange-colored fruit, with a highly-perfumed rind, scarcely thicker than brown paper, and not adhering to the pulp, which is exceedingly sweet, and of a different flavor from any other orange. The orange-groves in this colony are comparatively new, and the trees young; but in some of the older orchards the trees have attained a height of thirty-five feet, the diameter from the extremities of the branches being thirty-three feet. From trees of this size 12,000 oranges are occasionally picked during the year. In the markets of Sidney, Melbourne, &c., these oranges bring *6d.* a dozen wholesale, which would give £25, or $125, as the value of the yield of a single tree.

The Mandarin variety, mentioned above, has here produced 4,200 oranges upon one tree during the season. To keep up the fertility of the soil of the orange-groves guano is extensively used. This is spread around the tree on the surface of the land, and is then touched in with the hoe, which treatment of the soil has the effect of making the trees and the fruit beautifully clean.

In South Australia, the orange and lemon thrive well, and many persons are engaged in their cultivation. From official reports we learn that every year about £50,000 worth of oranges are exported from New South Wales and South Australia, to Victoria and other colonies.

One grove in the vicinity of Sidney, it is reported, sold in a year, for exportation, 40,000 dozen oranges, leaving 20,000 for home consumption.

Italy carries on a large trade in oranges. The shipments to the United States have reached as many as 600,000 boxes per annum. Their exports to all countries, from the last official returns, were 94,236,000 kilogrammes of two and a half pounds.

The export of oranges and lemons forms an important branch of commerce in Spain. The United States receives many of these shipments.

The orange-peel is furnished by many of these countries in large quantities to Holland, France, and Germany, where it is consumed in making liquors and sirups.

Several hundred tons of candied orange-peel are said to be used in England alone.

Greece exports over 16,000,000 oranges every year.

About 8,000 cases of oranges are annually exported from Malaga.

In Central India there is a variety of the orange (Citrus aurantium) extensively cultivated, which produces two crops a year. To prevent exhaustion of the trees, however, only alternate fruiting is allowed. The bitter orange is of this variety. This furnishes from its flowers the Neroli oil, so delicious and costly as a scent. The high prices of the oil of orange, of citron, and bergamot in the East, for purposes of perfumery, should attract attention here, and stimulate an industry in this particular.

From Cuba, Jamaica, Trinidad, and the Bahamas large importations of oranges are received in the United States, which, with other fruits, is the chief commerce of these islands.

Nassau, in New Providence, sends to the United States on an average

about 7,594 barrels of oranges every year, and the islands of Abaco, Andros, and Eleuthera, together with New Providence—the Bahamas—a total of 16,000.

West Indian oranges are preferred in the markets, on account of their superior flavor, to those brought from Europe.

The orange trade between Tahiti and San Francisco has been very important and profitable, the production in Tahiti being about 11,260,000 oranges. This trade has declined, however, in consequence of the cultivation and production of this fruit in Southern California.

For nearly 500 miles along the coast of California the orange grows luxuriantly, and its cultivation is receiving deserved attention. Many of the orange trees in the southern parts of this State yield $100 profit per annum. It is stated that there are over 1,400 lemon-trees now in bearing in that State. Official statistics give 14,387 lemon-trees and 50,000 orange trees. San Francisco now receives more than half its supply from home productions. Its yearly requirements are reported to be over 12,000,000 oranges, of which about 5,000,000 are received from Tahiti and Mexico.

The manufacture of the essential oils of orange and lemon is a considerable industry in some of the West India and Pacific islands.

In Martinique large quantities of orange wine are made, which finds a ready market in Russia and Turkey.

The Louisiana orange crop for 1876 is estimated to have been over 32,000,000 oranges, which would represent about 70,000 trees, worth over $210,000.

The annual importation of oranges and lemons into the United States are over 200,000,000, amounting in value to about $600,000.

An idea of the age which orange-trees may attain is furnished by the history of the magnificent one in the orangery of the palace of Versailles, in France, known by the name of Grand Connétable or Grand Bourbon, which is now 451 years old. It grew from some slips of a bitter-orange planted in a pot at the commencement of the fifteenth century by Eleanor of Castile, wife of Charles III, King of Navarre. The young plants which sprang from seeds were kept in the same tubs at Pampelunar until 1584. In 1799, more than two centuries after, they were removed to Versailles. The Grand Connétable, which may be regarded as the senior of living orange-trees, is still perfectly vigorous and does not exhibit any signs of decay.

CRANBERRY CULTURE IN NEW JERSEY.

By Thos. Taylor, *Microscopist.*

In accordance with instructions I proceeded to New Egypt, Ocean county, New Jersey, and attended the second annual convention of the New Jersey Cranberry Association, held at that place in October last. My letter of instruction was read, and the convention, by a unanimous vote, passed resolutions of thanks to the Commissioner for his kindly act in sending a representative to participate in its deliberations. I was invited to take part in the general discussions, which related mostly to the diseases of the cranberry vine and fruit, and the soil and climate best

suited to their cultivation. As cranberry cultivators are much divided in their opinions as to some of the causes of failure of vines, a committee was appointed by the society, consisting of the following-named gentlemen: Messrs. Budd, Crane, Rider, and Satterwaite, and Drs. Bean, Beakley, Merriman, and myself, with instructions to make a thorough investigation of the whole subject and report the result.

Since the convention adjourned I have made a very thorough investigation of the condition of many of the principal cranberry plantations in that State, located in the vicinity of New Egypt, Pemberton, Bricksburgh, Manchester, Atsion, Cedar Lake, Chewville, Hammonton, Atco, Waterford, Vineland, and other places. I had the hearty co-operation of the principal cranberry growers at every place visited. The results of my investigations will, I hope, give renewed vigor to cranberry interests, as many of the facts ascertained are unknown to the members of the association generally.

SOIL.

Cranberry soil is known under a variety of names.

1st. Savanna, which consists simply of sand and a small proportion of peaty matter.

2d. Black sand, which consists of pure sand combined with a large proportion of peaty matter.

3d. Turf, or moss and sand combined.

4th. Solid peat, free of sand.

5th. Pure white sand, watered by solutions of peat from adjacent bog-lands.

SAVANNA SOIL.

Experience demonstrates that the savanna soils are unreliable from eight to ten years after planting. I have seen hundreds of acres of such soil fail to produce healthy vines, especially on high lands. It is affirmed that such lands formerly produced well. Light savanna soil contains only about 2½ per cent. of vegetable matter. It is frequent on high lands, and depends on winter rains for flooding. Most of the savannas I have examined have a loose, sandy subsoil, and rains pass through them freely. In seasons of drought roots in such lands suffer severely, and there is reason to believe that the continued destruction of the forests of this and other States affects materially the rain-fall and consequently the plant-growth of late years. Since the cranberry is essentially a water plant, frequent showers are necessary to vines planted in this character of soil during the entire spring and even until the berry is fully matured.

Black sand, with a subsoil of clay, even on high land, seems, from my recent investigations, to give fine results. In company with Mr. Theo. Budd, of Pemberton, Burlington county, I visited a number of cranberry plantations of this class. The vines were growing in profusion and were loaded with good-sized berries. On one of these plantations the owner (Mr. Powell) stated that the yield could not be less than 450 bushels to the acre, valued at $3 per bushel. Such plantations are worth not less than $2,000 per acre. In the vicinity of Bricksburg I visited a two-acre bog, known as Pruden's Bog, situated in the midst of a dense thicket of trees. This property is owned by Mr. Darrow, who informed me that this bog had not cost for attendance during the last four years over $5. The berries always come to maturity, and the crop has fine keeping qualities.

The soil is springy, is composed of black sand, and has good drainage. These soils have generally about 18 inches in depth of black sand resting

on a subsoil of clay or hard-pan. I have seen strikingly illustrated the folly of removing the turf before planting from light sandy soil. This is now seldom done, as it has been demonstrated that by this system much valuable fertile soil is lost. Some growers are now returning the top-rotted moss to the land from which it was originally removed, and in some cases, I am informed, with marked beneficial results. I have always observed that the mosses used in combination with savanna lands never exhibit fermenting qualities, but by a slow process of oxydation is converted into soluble and insoluble humus matter, which always contains more or less ammonia.

Solid peaty matter, free of sand, is found in various conditions from a few inches to many feet in thickness. I have found it 6 feet deep in a fermenting condition, and again I have seen it 6 feet deep, solid in texture, and free from all odor or fermenting qualities. Mr. N. H. Bishop, of Manahawkin, has a plantation of this sort. An abundance of water is at hand. Sometimes as much as eight inches of sand has been spread on such muck, and the vines planted in the pure sand. Mr. Bishop's prize land, which grew the largest amount of cranberries per acre, was of this character. Recent observations demonstrate that dense fermenting muck may be greatly improved by the use of caustic lime and a bountiful supply of water. The lime reduces the consistency of solid peat, and the running water removes the useless salts of lime which form during the fermentation and oxidation of the mass. The peaty matter, in the course of two or three years, is rendered very porous and free from all bad odors. As much as 100 bushels of lime to the acre have been used to advantage on heavy muck lands.

I visited the cranberry lands of the Cedar Lake Land Company in Atlantic county. Extensive arrangements are being made by this company to lay out several new mill-pond bottoms with cranberry-vines. Old Dutch mill pond of Cedar Lake was made about one hundred and forty years ago, and the mill has been in constant running order during that period. The accumulation of organic sediment in the dam has at present a depth of from one to four feet. On the 16th of May, 1876, the water was drawn off, leaving the mud exposed. On the 29th of the same month the company commenced planting. During the following four weeks fifteen acres of this pond were planted with wild vines, thirty-five barrels being used on each acre. The usual mode of planting is to take about six cuttings, and insert them, say about four inches deep, in the ground, allowing the hills to be about one foot apart. The vines have at this date runners varying from one to two feet in length, and are growing thriftily. In a year or two it is proposed to spread over these vines white sharp sand, to the depth of about one inch, which will cause the runners to take root, the object being to cover the ground as quickly as possible with them. Vines suitable for planting are worth from 75 cents to $1.50 per barrel, depending somewhat on the distance to point of delivery.

A flood-gate, a very important item in cranberry culture, was in course of construction for this pond. These gates cost from $300 to $600 each. In many places, such as on level and high lands, a cheap mode of ditching and a very inexpensive gate, formed of a few slabs, are all that is necessary. In some cases nature provides all the requisites. Flooding protects the vines from winter frost, and is one of the means employed to destroy mice, roaches, grasshoppers, and a variety of insects which consume or destroy many thousand bushels of berries annually. Ice is sometimes very destructive to vines when proper attention is not paid to winter flooding. Should a severe frost set in before the vines are

wholly covered with water, ice will form on the surface, thus securing the tops in ice. A further supply of water flowing under the ice may float it upward and drag the vines from their roots. At Cape Cod, Mass., the cranberry cultivators inform me that they take advantage of the winter, and sand their vines while covered with ice. They cart the sand over the ice and spread it evenly over its surface. When it melts the sand is deposited over the vines. This practice is not only economical, but it also saves the vines from being trampled upon. At Cedar Lake ditching is done at the following rates on muck and sand foundations: A ditch five feet wide by two feet deep costs $1 per rod; four feet wide by two feet deep, 60 cents per rod.

I find, under certain conditions, that the cranberry will grow where in theory it could not survive. The cranberry plantation of Mr. Chew, on Hospitality Stream, near Cedar Lake, presents generally fine conditions for experiments. I have here seen several acres of pure white sand, on hard-pan bottom—carbonate of iron combined with sand, and having a slight odor of sulphuretted hydrogen—producing fine vines and berries in abundance. But in this case the sand was watered by a stream which was saturated with peaty matter. Mr. Roberts, of Cape Cod, informed me, on my first visit to that place three years ago, that he had seen berries growing in healthy condition on the sandy beach, watered by the overflow of a peaty stream. Mr. Christian L. Sharp, whose plantation is near by Mr. Chew's, showed me an acre of cranberry-vines bearing fine berries, free from rot, growing on sawdust; but in this case the sawdust was also saturated with a moving flow of peaty matter. It is not uncommon to find cranberry-vines watered with a solution of bicarbonate of iron, combined with peaty matter, without any damage to the berries.

Mr. Hinchman, of New Bedford, directed my attention to a small spring which flowed among his vines, the water from which was charged with sulphuretted hydrogen, without any injury to them. Solutions of bicarbonate of iron may have a beneficial effect on cranberry land, since such solutions frequently deposit masses of iron ore, at a depth of about eighteen inches from the surface. In such case one equivalent of carbonic acid is liberated, which will be conveyed by the water to the roots of the vines and absorbed as plant-food. Such, at least, is the conviction of some vegetable physiologists.

GRASSHOPPERS.

Mr. E. Z. Collins, of Waterford, Camden county, owner of the Burnt Mills Plantation, exhibited by drawings a very simple combination of spars, canvas, and sheet-tin trays, for the destruction of grasshoppers. The spars combined represent the Roman letter A, along the sides of which the trays and canvas are secured. The canvas is stretched perpendicularly, extending upward about two feet and downward about one foot, touching the top of the vines when in use. The operator walks within the frame, which is strapped over his shoulder. The trays are filled with tar and the canvas is smeared with it. When the person moves along with the frame-work, the grasshoppers are thrown on the tar and secured. From one peck to a half bushel may be destroyed in this way each day. Crickets are not caught by this device. I am informed that mice and crickets eat the berries, while the grasshoppers eat the seeds. Many thousands of bushels of fruit are destroyed annually by these pests.

FERTILIZERS.

Cranberry-cultivators are divided in opinion on the subject of fertilizers—as to their use in any case, the kind, quality, and quantity to be used, if used at all, and whether in the spring or in the fall. Mr. Chew informs me that he has used guano to great advantage, and states from his experience that one pound of this fertilizer will produce one extra bushel of berries on his soil. One application on heavy soil showed evidence of its value for several years afterward. He uses guano as follows: Two quarts of guano, combined with one pail of moist sand, is spread on the soil at such a rate that from 50 to 250 pounds of guano will be required on each acre. Dr. Merriman, of Bricksburgh, has used guano and bone-dust to the advantage of growth of vines and size of berries; but it has no visible influence in preventing rot or scald. Several other growers informed me of its beneficial use. On high-land savannas, in dry seasons, guano may prove injurious, in consequence of its free ammonia, which acts as a caustic on the roots, while in seasons of light rains it will prove of great advantage. Excessive fertilization produces a rank crop of vines, and frequently of the fruit. The perfect growth of berries can only be attained by the production of light wood or vines. The continued growth of succulent vines, caused by over-fertilization, deprives the berries of material which should be used for their growth and perfection toward the ripening season.

IRRIGATION AND LIMING.

About three years ago I visited, among other places in New Jersey, Long Swamp, a plantation consisting of about thirty acres, the property of Messrs. C. G. and E. W. Crane. The soil, although generally good, showed, in some places a decided indication of fermentation. Some of the plantations of Dr. Merriman, and of those near Atsion, under the supervision of Mr. Rider, were in a like condition. Liming and irrigation were recommended and faithfully applied by the respective parties. During the first two years after the application of the lime and special irrigation no benefit was observed; but during the present year sound berries are found where formerly rot prevailed. In company with the respective owners I examined their plantations, and found, to their surprise and to my satisfaction, that what was formerly heavy, dense masses of fermenting peat, had been changed to light, porous matter in each case, and wholly free of all bad odor. On a ten-acre bog, adjoining Dr. Merriman's, which was wholly neglected as regards liming and irrigation, I found the berries all decaying. No change had taken place in the condition of the soil since my former visit. The soil was sour from surface to subsoil.

NATURAL CRANBERRY BOGS.

It is generally supposed that wherever cranberries grow wild, on marsh land, it will prove highly remunerative if cultivated. Hundreds of thousands of dollars have frequently been squandered on such lands, and the question is frequently asked, "Why is it that such lands, under cultivation, do not yield profitable returns?" I have examined a bog formerly of this character, containing 300 acres, near Ellwood, Atlantic county, New Jersey. When a wild or uncultivated bog, the rain was held on the surface of the soil by the mosses which covered it. The mosses retained the moisture, and while the soil was kept cool by evaporation, it supplied plant-food continually to the roots and caused the vines to grow luxuriantly. In reclaiming this bog land thorough drainage was first effected by means of ditches. The surface water was withdrawn and the

moss killed by turning it over with the plow and exposing it to the sun to rot. Vines were planted over the entire bog, but in the course of several years it is found that the berries failed to mature to that high acid condition so necessary for their preservation. Their starch was prematurely converted into fruit-sugar, the precursor of rot. It was found that the drainage generally necessary for bog land proved, in this case at least, prejudicial, perhaps in consequence of a general deficiency of water-supply. It has been proposed by the directors of the company who own this bog to sink extensive wells, and, by the aid of windmills, collect in a dam a sufficient amount of water for spring and summer irrigation. I have seen on the lands of Mr. Roberts, at Norwich, Cape Cod, a bog of about six acres which was flooded successfully by a windmill, which worked two pumps of eight-inch cylinders each.

STORING CRANBERRIES.

When cranberries are gathered under high temperatures they should be placed under shade, in open trays, to cool. Mr. Chew recommends that they be packed as lightly as possible in boxes (if the berries are sound), and placed in dry, air-tight cellars. The top boxes should be covered, in order to prevent the moisture near the ceiling from condensing on the upper tier. Without this precaution the berries are apt to rot.

COLORING WILD BERRIES.

It is the custom of the West Jersey Land Company to gather the wild berries while green, to prevent them from being stolen by tramps. An open shed is prepared, under which the berries are placed on the bare ground, spread evenly, and exposed day and night from six to eight weeks to color. I have seen the berries colored to a high red by this process and perfectly free from rot. The cultivated berries are not exposed in this way, but are first cooled, cleaned, and freed from all unhealthy berries by handpicking, and sometimes by machinery. They are then boxed for market and stamped with the society brand, which is a guarantee of proper measurement.

CRANBERRY-VINES.

There are two varieties of vines, the American cranberry (*Oxycoccus Macrocarpus*), which is indigenous to our continent, and is found in the wild state in North and South America on the sea-coast and along the margins of the great lakes, and the English cranberry (*Oxycoccus Palustris*) is found growing in the fenny districts of England. It is a small, acrid berry, of a pale-red color when ripe. Its cultivation for the market is very limited. Sometimes unprincipled persons dispose of this worthless variety to American cranberry-growers. The Brunette bog, near Bricksburgh, consists of about four acres of this variety. They were planted about seven years ago, and have proved to be entirely worthless, the berries being very small and the vines unthrifty. The owner of this bog has waited for seven years, expecting all this time to reap American berries, she having purchased the vine supposing it to be the American variety. I have seen several patches of this variety in different parts of New Jersey. The berries are about the size of an ordinary pea. We recommended their destruction by burning, preparatory to planting the American variety on the same ground.

SULPHURING VINES.

About three years ago the use of sulphur was recommended as an antidote to rot of the berry. It was extensively used, but without satis-

factory results. On my last visit to Parkdale, Atsion, Mr. Rider showed me vines which had been sulphured three years ago. They were on a broad ridge between two ditches. One half of the ridge was limed with caustic lime, while the other half was sprinkled with the flowers of sulphur. The sulphured vines have a decidedly greenish-yellow hue, while those covered with lime have a very dark green color, and are heavily loaded with berries. The sulphured vines bear very few.

SOLAR HEAT.

It is generally supposed that the cranberry-plant will not grow successfully farther south than Southern New Jersey. This belief is based upon the fact that a large portion of the crop is destroyed by excessive high temperatures, but when we find in those favored cranberry lands ten acres of successful vines and berries side by side with as many acres rotting and scalding under the same climatic conditions, we come to the conclusion that if the solar rays were directly the cause of rot all would suffer alike, as it is well known that many bogs for a period of from ten to twenty years have successfully grown fruit free of rot. High temperatures, therefore, cannot be the general cause of rot. Indeed it seems to perfect the fruit when the soil and rains are highly favorable. What is wanted is a rich soil, a constantly-moving moisture or water at the roots, and a sufficiently high temperature. Springy land has been found to be very favorable to the growth of sound vines and berries. I am convinced that in the District of Columbia, and in the States of Maryland and Virginia, there are many patches of bog-lands suitable for cranberry culture, which are of little or no value at present.

We have sometimes been called upon to explain why it is that on the same branch of vine sound and rotten berries will frequently grow side by side. It is a well-known fact that the whole vine does not blossom at the same time. There is a first and second bloom on the same pedicle. Berries form on the same stalk which bears the blossom for a second and third berry. The first bloom and berry may get its first start with rain and sunshine sufficient to bring it to perfection, while the second bloom and fruit may be deprived of this favorable start.

PINE STUMPS.

In cranberry plantations I have frequently observed berries grow to maturity on rotten pine stumps, showing no signs of rot or scald, while rot of the berry prevailed on the vines surrounding them. As this fact is well known to cranberry cultivators it may be of interest for them to know the chemical composition of the ashes of pine wood, as given by Saac's analysis and published in Smithsonian Report No. 27, page 201, which is as follows:

Silica	10.8667
Sulphuric acid	1.2844
Phosphoric acid	3.5569
Chlorine	0.1229
Peroxide of iron	2.6018
Protoxide of manganese	2.6498
Magnesia	3.9873
Lime	58.6475
Potassa	2.3076
Soda	13.9751

PROFITABLE CULTIVATION OF PEAT LANDS.

While on a visit to Washington last summer, the Hon. Lyon Playfair, M. P., of Scotland, placed in my hands duplicates of a series of letters written by himself, relating to the reclamation of the bog lands of North Germany. Professor Playfair was pleased to know that the cranberry was cultivated successfully in the United States, and he expressed the belief that the adoption of the German methods of bog-land cultivation would prove of great value to the State of New Jersey. He is one of the most eminent chemists of Great Britain, and is peculiarly fitted to give advice on this subject.

The German plan consists in making deep ditches at intervals of 25 yards, the ditch being 5 yards wide. Under the clay on which the peat rests is generally sand, which is taken out of the ditch and put in heaps. The surface of the ground is now leveled, and the sand is spread on the top of the peat to a depth of four or five inches. Horses can now be brought on the land, but before the sand was placed on it they would have sunk to their girths. The land, being partially dried by the ditches, is now worked by the subsoil-plow, but no mixture of the peat and sand is made. It is then dressed with artificial manures, and herein is contained the whole element of success. Although there is an abundance of stable dung, it is not used for these bog lands. For this purpose only three manures are used, kianit, dissolved bones, and nitrate of soda. The last two are familiar to all farmers, but the first is not so common. Kianit is a mineral found on the top of the rock salt, on the borders of Anhalt and Prussia, near Strassfurth. It is essentially a sulphate of potash and magnesia, with a certain amount of common salt. It is as a potash salt that its value chiefly depends, and its sale as a manure is now becoming very extensive. At the farm Principeel, the manures are added to each hectare in the following quantities: 800 pounds kianit, 800 pounds of dissolved bones, 440 pounds of nitrate of soda.

These manures must be put on the soil before the seed is sown. After the land is first reclaimed, oats and rye are the crops for which it is best fitted, but in a year it will grow any kind. On such prepared land they grow rape, beans, pease, barley, wheat, rye, oats, sugar-beet, beet, turnips, Indian corn, clover, and grass. Professor Playfair visited the improved dismal swamp of Mr. Nering, a gentleman who is much interested in this new method of culture, and who paid for the swamp for the purposes of experiment, $50,000. On Mr. Playfair's visit he had only reclaimed 400 out of his 600 hectares. In doing so he had to erect farm buildings, make roads, and cut canals to carry away water from the deep ditches, which has already cost him $60,000 in addition to his purchase-money. This gentleman keeps his books with scrupulous care, and he assured Professor Playfair that his last year's profits were $25,000, or 22 per cent. upon his outlay. The cost of nitrate of soda is a diminishing one, as it is less and less required as the peat becomes weathered and broken up; but the kianit and the bones require always to be used in the same quantities, year by year.

EUROPEAN AGRICULTURAL STATISTICS.

The statistical returns of Great Britain are made annually by the officers of the inland revenue department, and tabulated and published in the statistical department of the Board of Trade under the direction of the superintendent and statistician, R. Giffen, esq. The annual returns are now made on the 4th of June instead of the 24th, and are presented to the public about the 21st of August. The main features of these returns are the areas in crops and the numbers of farm animals. The number of "holdings" or farms is given, and in recent years inquiry has been made concerning allotments, or small holdings of laborers—from one to five acres, and also those of less than one.

For the year 1867 the number of occupiers of land is 556,962, with an acreage of 31,711,000; average to each, 57 acres.

In Ireland returns are made under the direction of the registrar-general. They aggregate an area of 15,427,000 acres in 1877. In the Isle of Man 94,433 acres are returned, and the Channel Islands 30,204 acres. This is exclusive of heath and mountain pasture land and of woods and plantations.

The total area or superficial surface of the United Kingdom is last reported at 77,828,947 acres. Of this, England has 32,597,398; Wales, 4,721,823; Scotland, 19,496,132; Ireland, 20,819,947. England is as large as North Carolina or Alabama, or New York and New Jersey taken together. Wales is nearly the size of Massachusetts. Scotland is nearly as large as Indiana or South Carolina. The three together, constituting Great Britain, are nearly equaled in territory by Minnesota and exceeded by Oregon. Indiana comes nearest the size of Ireland, but is 4 per cent. larger. The United Kingdom surpasses in area any of our States except California and Texas, but is inferior in size to the Territories Dakota, Arizona, Montana, and New Mexico, and Alaska is about seven times as large; it has a little more than four-tenths the area of Texas.

Meat production is the prime consideration in British agriculture; bread crops are of next importance. Wheat-growing is slowly declining in area; the yield has been increased 1 to $1\frac{1}{2}$ bushels in the past generation, 5 bushels within one hundred years, and is now estimated at 28 bushels. The best authorities make the yield for the past ten years within a small fraction of 28 bushels, notwithstanding the low yield of the three past years in succession.

There is one sheep to $1\frac{1}{2}$ cultivated acres in the United Kingdom, one to $1\frac{1}{8}$ in Great Britain, and three sheep to 2 acres in crops in Scotland, though there are areas of mountain pasturage in the latter country not counted as cultivated. The proportion of cattle to acreage in grasses and all other crops is less than one to five in the United Kingdom. It is assumed that one-fourth of the cattle are killed annually; one-fourth of the sheep in Scotland, and one-third in England. The average value of beeves was estimated on good authority, a few years ago, at an equivalent of \$80 in England, \$70 in Scotland, and \$50 in Ireland. A constant tendency exists to increase in price. The average dressed weight of British cattle is estimated at 600 pounds, which is 20 per cent. higher than the average of imported beeves.

EXPERIMENTS OF PROFESSOR LAWS.

The influence of the unfavorable seasons of the past three years is observable alike in the entire wheat area and in the results of the notable

experiments of Laws and Gilbert. Reduction of the averages from this cause makes the average yield in each class somewhat less for the period of ten years than for the longer period of twenty-six years from 1852. Prior to 1874 the average yield per acre was acknowledged to have advanced about 1½ bushels in thirty years, but if the past three years are included in a new period, the gain is more than counterbalanced. The following table of results of the Laws experiments gives the yield in bushels of wheat:

Harvests.	Without manure, plat 3.	Farm-yard manure, plat 2.	Artificial manures.			Means, plats 7, 8, 9.	Means, plats 3, 2, and 7, 8, 9.
			Plat 7.	Plat 8.	Plat 9.		
1867	8⅞	27½	22¼	30⅛	29⅛	27¼	21¼
1868	16⅝	41¾	39⅞	46½	47¾	44¾	34⅜
1869	14¼	38¼	28½	34¾	39	34⅛	28⅞
1870	15	36½	40½	45¼	45½	43¾	31¾
1871	9¼	39	22¼	27⅝	34⅜	28⅛	25½
1872	10¾	32⅜	29¾	35½	40¾	35⅜	26⅛
1873	11¾	26¾	22	27½	35⅞	28½	22⅜
1874	11½	39¼	39½	40½	38¼	39½	30
1875	8⅝	28¾	25⅞	29⅞	30½	28¾	22
1876	8⅛	23⅞	23½	29½	33¼	28¾	20¼
1877	8⅞	24⅛	19⅞	24¾	40⅛	28¼	20⅜*
Average, 10 years, 1867-'76	11½	33½	29½	34¾	37½	33⅞	26¼†
Average, 26 years, 1852-'77	10½	34⅝	33⅜	36¼	36⅞	35¼	27⅞‡

WEIGHT PER BUSHEL.

Harvests.	Without manure, plat 3.	Farm-yard manure, plat 2.	Plat 7.	Plat 8.	Plat 9.	Means, plats 7, 8, 9.	Means, plats 3, 2, and 7, 8, 9.
1867	56. 1	61. 4	60. 0	60. 7	59. 9	60. 5	59. 4
1868	61. 0	61. 6	61. 1	62. 0	61. 0	61. 4	61. 3
1869	56. 1	56. 9	57. 4	57. 2	57. 1	57. 2	56. 8
1870	61. 7	63. 4	63. 3	63. 7	62. 7	63. 2	62. 8
1871	54. 8	60. 0	56. 6	57. 7	58. 6	57. 6	57. 5
1872	59. 0	60. 7	60. 2	60. 4	60. 0	60. 2	60. 0
1873	57. 0	58. 1	57. 1	56. 9	57. 1	57. 0	57. 4
1874	58. 3	60. 2	59. 8	59. 9	60. 4	50. 0	59. 5
1875	60. 0	60. 6	59. 5	58. 2	57. 9	58. 5	59. 7
1876	59. 0	62. 4	62. 9	62. 9	62. 7	62. 8	61. 4
1877	58. 9	59. 1	59. 2	59. 2	57. 9	58. 8	58. 9
Average, 10 years, 1867-'76	58. 3	60. 5	59. 9	60. 0	59. 7	59. 9	59. 6
Average, 26 years, 1852-'77	57. 8	60. 1	59. 4	59. 1	58. 6	59. 0	59. 0

* Equal to 19¾ bushels, at 61 pounds per bushel.
† Equal to 25⅝ bushels, at 61 pounds per bushel.
‡ Equal to 27 bushels, at 61 pounds per bushel.

TOTAL AREA IN CROPS.

The increase of area in cultivation in the United Kingdom of Great Britain and Ireland, for ten years past, has been very nearly in proportion to the increase of population. In 1868, by the official returns, the land in cultivation aggregated 45,652,545 acres; in 1867, 47,263,185 acres; an increase of 3½ per cent. The principal gain has been made in England; Scotland has also been gaining steadily, quite as much in proportion though less than one-fifth as much in acreage—each between 5 and 6 per cent. Wales has retrograded, and Ireland slightly.

Of the total area in 1868 there were nearly 59 acres in cultivation to every hundred; in 1877 there were almost 61. In this area is included "corn" or cereal crops, roots, clover, and grasses in rotation and permanent pasture. The remaining 39 per cent. of the area is occupied by woods and forest plantations, cities, towns, roads, railways, lakes, fens, and mountain wastes. A distinctive feature in British agriculture, in

which it leads the world, is its large proportion of restorative crops, by which the exhaustion from cereal cropping is remedied in judicious rotation. Not many years ago the proportion of "green" to "white" crops was nearly two to one; at the present time it is nearly three to one. The changes in ten years are not inconsiderable. England has declined in corn crops, since 1869, from 33.3 to 30 per cent.; Scotland, from 31.9 to 30.2; Ireland, from 14.1 to 12.1. In permanent pasture England has advanced since 1868 from 42.1 to 44.7 per cent.; Scotland, from 23 to 24.4; Ireland, from 64.2 to 65.7. There has been an advance also in grasses in rotation: England, from 10.3 per cent. in 1868 to 11.3; Scotland, from 28.6 to 30.1; Ireland, from 10.9 to 12.5.

RECENT YIELD OF CROPS IN GERMANY.

The official crop returns of Germany are substantially upon the same basis as those made to the Department of Agriculture in this country, especially the reports of condition of growing crops. The returns of harvested crops, instead of comparing with the preceding, the percentage of a full or normal crop is given, not an average crop, as in ten years there are few crops coming up to 100, which is the normal or unimpaired crop. For the whole period, wheat and clover-hay stand highest, falling but one-tenth below the standard of perfection in cropping. Oats and sugar-beets are next in order, being important crops, commanding the especial care of husbandmen.

Table giving the average percentages of the harvested crops in Prussia from 1866 *to* 1875.

Years.	Wheat.	Spelt.	Rye.	Barley.	Oats.	Pease.	Beans.	Buckwheat.	Potatoes.	Rape.	Sugar-beets.	Meadow hay.	Clover.	Lupines.
1866	90		81	85	88	84	....	89	71	83	96	..	..	95
1867	74	82	74	87	97	91	87	83	77	66	79	106	104	105
1868	99	101	94	80	79	82	69	54	95	88	82	86	75	55
1869	97	91	92	94	89	87	83	62	85	73	88	85	59	86
1870	78	64	86	88	86	73	82	87	85	60	94	83	69	86
1871	84	78	81	94	101	95	93	73	59	73	78	96	106	92
1872	92	93	81	93	99	91	93	70	100	101	96	92	98	93
1873	92	91	75	87	92	82	86	77	78	92	90	92	73	82
1874	104	71	96	84	78	59	59	66	101	78	80	68	65	68
1875	85	70	87	83	84	73	84	77	86	66	99	86	75	92
Averages	90	82	85	88	89	82	82	74	84	78	88	88	90	85

(Landwirthschaftliches Jahrbuch, Berlin.)

BEET SUGAR IN GERMANY.

A record of the facts of beet-sugar production in Germany, as given in official "Statistics of the German Empire," shows that heavy productions of roots are inimical to a large yield of sugar. Comparing the results in the year ending August 31, 1874, with those of the year ending August 31, 1875, it is seen that 545.74 zentners of beets per hectare (12.17 tons of 2,000 pounds per acre) required 12.12 to make one of sugar, and a lighter yield, 411.89 zentners per hectare (9.18 tons per acre), required only 10.75 to 1; equivalent in one case to a yield of 8.25 per cent. of sugar, and in the other to 9.3 per cent.

The land required for this industry was equivalent to 227,869 and 218,764 acres in the respective years, being less than half the area

devoted to tobacco in this country, and somewhat larger than the area planted in cane in the United States.

The average quantity of beets manufactured in each factory in these years was 9,137 tons (of 2,000 pounds) and 11,582 respectively.

The following comparison of statistics of manufacture is given for each of the countries of the German Empire engaged in the beet-sugar industry:

Countries.	Factories in operation.	Manufactured in the factories.		
		Home produce.	Imported.	Total.
		*Zentners.**	*Zentners.*	*Zentners.*
Prussia	255	28,021,878	13,471,484	41,493,362
Bavaria	2	174,710	104,860	279,570
Würtemberg	5	484,073	1,084,945	1,569,018
Baden	1	166,196	504,954	671,150
Mecklenburg	1	118,105	7,985	126,090
Thuringia (including Allstedt and Oldislenben)	5	618,961	154,722	773,683
Brunswick	28	4,837,066	823,293	5,660,359
Anhalt	34	3,561,527	739,183	4,300,710
German Empire, 1875	331	37,982,516	16,891,426	54,873,942
German Empire, 1874	335	48,315,260	22,085,452	70,400,712
Difference { + = more, − = less } in 1875	−4	−10,332,744	−5,194,026	−15,526,770

Countries.	Amount of raw sugar produced.	Quantity of beets required to make 1 zentner of beet sugar.	Area in hectares of home produce of beets.	Product per hectare.
	Zentners.	*Zentners.*		*Ztrs.*
Prussia	3,852,909	10.77	68,980.03	406.23
Bavaria	23,923	11.69	476.32	366.79
Würtemberg	141,873	11.06	865.06	559.57
Baden	60,440	11.10	342.50	485.24
Mecklenburg	10,365	12.16	312.50	377.94
Thuringia (including Allstedt and Oldislenben)	75,205	10.29	1,755.17	352.65
Brunswick	539,499	10.49	8,760.76	552.13
Anhalt	401,383	10.71	10,721.30	332.19
German Empire, 1875	5,105,597	10.75	92,213.66	411.80
German Empire, 1874	5,806,942	12.12	88,529.36	545.74
Difference { + = more, − = less } in 1875	−701,345	−1.37	+3,684.30	−133.85

* Zentner = 110.23 pounds avoirdupois.

STARCH SUGAR.

There were fifty factories reported in operation for the year 1874–'75, in the German Empire, of which forty were in Prussia:

The quantity of starch used in making starch sugar was as follows:

1873–'74	223,420	63,898	483,836	25,549
1874–'75	275,978	49,510	558,442	48,749

ERRATA.

On page 151, thirty-second line from top, the yield per acre of wheat in 1877 should read "13.8."

On page 152, in wheat table, the product in 1877 should read, "364,194,146"; area in 1877, "26,277,548"; value in 1877, "394,695,779"; yield per acre in 1877, "13.8+"; price per bushel in 1877, "$1.08.3+"; value per acre in 1877, "$15.02"; total production from 1870 to 1877, inclusive, "2,251,648,246"; total area, "187,219,627"; total value, "$2,450,696,009"; average production, "281,456,031"; average area, "23,402,453"; average value, "$306,337,001."

On page 154, thirteenth line from top, average value of oats for eight years should read, "$111,034,139"; same page, bottom line, the average yield per acre of rye should read, "13.8—"; average price, $0.74.2+"; average value per acre, "$10.24."

On page 155, second line from bottom, total value of potatoes for eight years should read, "$594,324,911"; same page, bottom line, the average value per acre of potatoes should read, "$51.56."

On page 156, third line from top, the year should read, "1877." On same page, thirteenth line from bottom, should read, "4¾ million bales."

On page 157, seventh line from bottom, wheat production of 1877 in trans-Mississippi region should read, "151,959,346." On same page, sixth line from bottom, total wheat production in 1877 should read, "364,194,146."

On page 158, fourth line from top, percentage of wheat crop of 1877 grown on Atlantic coast should read, "17.7." Same page, fifth line, percentage of crop grown in central belt should read, "40.6." Same page, sixth line, percentage in trans-Mississippi region should read, "41.7." Same page, sixteenth line, product of wheat in the United States in 1877 should read, "364,194,146 bushels."

On page 163, the acreage of wheat in Iowa should read, "2,607,586."

On page 164, the total acreage of Iowa in principal crops should read, "10,799,822."

On page 165, the acreage of wheat in Iowa should read, "2,607,586." Same page, the total area in wheat in the United States should read, "26,277,548." Same page, the total value of wheat in the United States should read, "$394,695,779."

On page 170, the acreage of wheat in the United States should read, "26,277,548." Same page, the total acreage in the cereals and potatoes should read, "94,942,575." Same page, the acreage in cotton should read, "12,056,855." Same page, the average yield per acre of wheat should read, "13.8+." Same page, the average price per bushel of wheat should read, "$1.08.3+." Same page, the average value per acre of wheat should read, "$15.02."

On page 237, in first line of fourth paragraph, substitute the word "unripened" for "unrefined." Same page, in fifth line of fifth paragraph, after the word "and," substitute the word "there" for "that."

On page 241, in the sixth line of the first paragraph, the word "cupric" should be substituted for that of "cuprie." Same page, in last line but one of last paragraph, the word "sampphira" should read "samphire."

On page 243, in second line of analysis of sorghum and maize, the figures under head of sorghum should be 12.5, and under maize 10.1; and in third line under head of sorghum, same analysis, the figures should be 75.5, and under that of maize 79.1.

On page 244, in the third line of the third paragraph, the word "not" should be inserted between "of" and "securing."

On page 246, third line of fourth paragraph, the word "grows" should be inserted for the word "ranks," where the same occurs after the word "sorghum." Same page, fifth line of sixth paragraph, the figures "12 to 14, or 6 to 7," should read "14 to 12, or 7 to 6."

On page 248, third line from the bottom of the second paragraph, "5,000" should be substituted for the figures that read "500."

On page 250, in last line of analysis of juice of sorghum, the word "cane" should be substituted for that of "imphee."

On page 254, in second line of third paragraph, the words "will flow" should be inserted after the word "pipe." Same page, fourth line of fourth paragraph, the word "continuously" should be substituted for that of "continually"

On page 255, ninth line, first paragraph, the word "finisher" should be substituted for that of "furnace."

On page 256, the word "presence" should be substituted for that of "pressure," where the same occurs in the twelfth line of the fourth paragraph.

On page 259, in third line of second paragraph, the word "ensue" should be substituted for that of "issue." Same page, the fourth line of the fifth paragraph, after the word "pounds" should be inserted the words "second 3¼." Same page, in last line but one of sixth paragraph, the word "closely" should be substituted for that of "clearly."

On page 261, end of tenth line of fifth paragraph, after the word "room" the words "(C) crystallizing room" should be inserted.

On page 262, in line eight of third paragraph, substitute the word "bricklined" for the words "brick, lime." Same page, sixth line of sixth paragraph, between the words "the" and "juice," the words "density of the" should be inserted.

INDEX.

A.

B.